NEW YORK SEATTLE

MOTORSHIP

Devoted to Commercial and Naval Motor Vessels

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JUNE, 1921
Vol. 6 No. 6

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DIESEL MARINE ENGINES
FOR ALL CLASSES OF SHIPS

McINTOSH & SEYMOUR CORP.
AUBURN N.Y.U.S.A.

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EXCLUSIVE technical and non-technical articles on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

MOTORSHIP

(Trade Mark Registered)

PROFUSELY illustrated with photographic reproductions of the newest designs in international merchant motorship and Diesel-engine construction.

Vol. VI | New York, U. S. A., June, 1921 | No. 6

Cable Address—Freemote, New York

The Shipping Board's Motorship

"William Penn," a Twin-Screw B.&W. Diesel-Propelled Freighter of 12,375 Tons Deadweight and 4,500 i.h.p. Runs Trials.—Built on the Isherwood System.

AFTER a series of delays covering a period of nearly three years, the Shipping Board's first and only Diesel-driven motorship, "William Penn," has run trials on the Delaware. Although she is not an ideal ship, for reason we will presently outline, she attained a fuel economy that will never be equalled by anyone of the two thousand other merchant-vessels built under the jurisdiction of the Board, nor will her economy be nearly approached by any of the steamers now being converted to turbine-electric drive by the Board's order, for a fuel-consumption of 0.308 lb. per i.h.p. hour for all purposes was attained on the test trip. Her trials were completed with every success. Every other ship built by the Board has had a fuel-consumption of 300% (or over) higher.

The hull of the "William Penn" was a war-time contract, and was the last of a series of steamship hulls built at the Gloucester Yard of the Pusey & Jones Corporation, which is now closed down owing to no further steamship construction being available. Her propelling and engine-room auxiliary machinery were supplied by Burmeister & Wain of Copenhagen, Denmark, who built the Diesel-engines, while the installation work and sundry changes to the hull were carried out by their American licensees, the Wm. Cramp & Son Ship & Engine Building Company, Philadelphia, Pa., who also supplied and installed the deck machinery. She will be operated by the United American Lines of New York in the U. S.-Far East service. This vessel was constructed on the Isherwood system and has the following dimensions:

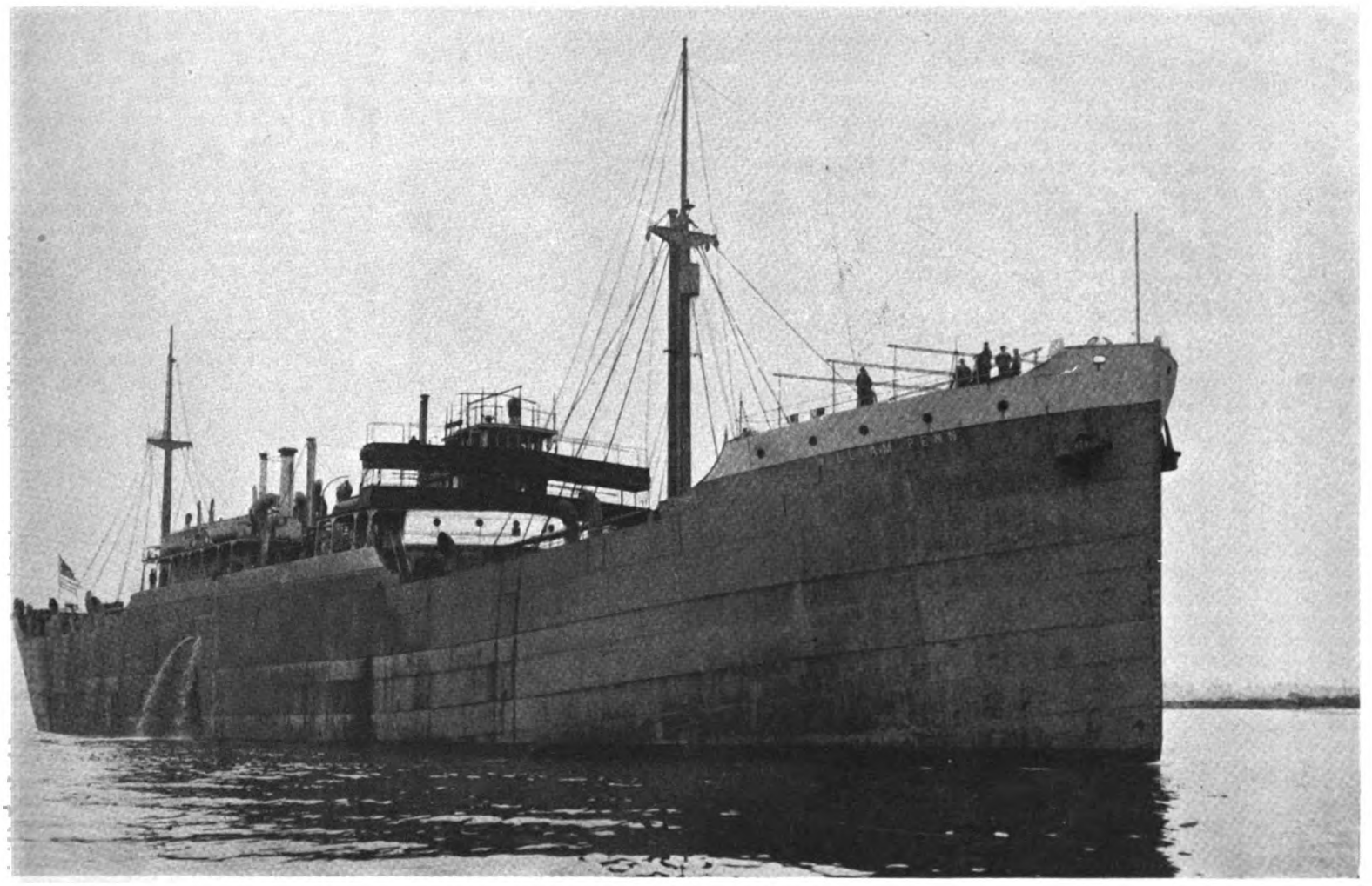
Loaded Displacement	17,100 tons
Dead-weight-capacity	12,375 tons
Net cargo—capacity on 10,000 miles voyage	11,725 tons
Fuel required on 10,000 miles voyage averaging. 4,000 i. h. p. & 10½ knots	500 tons
Most suitable loaded-speed	11 knots
Mean speed on trial	12.592 knots
Actual-cost of fuel for 10,000 mile voyage at 11 knots average speed	$7,335
Fuel-Bill of Sister Steamer at 10½ knots average speed, with fuel at $12.60 per ton.	$15,632
Fuel-Consumption of Sister Steamers for 10,000 miles voyage at 10½ knots average speed	1,320 tons
Cost in Fuel saved by "Wm. Penn" on 10,000 miles voyage	$8,297
Length (O. A.)	455'0"
Length (B. P.)	445'0"
Breadth (M. D.)	60'0"
Depth (M.D. to S.D.)	36'8"
Draught (loaded)	28'4¾"
Gross tonnage	8,168 tons
Net tonnage	5,214 tons
Hull Co-efficient	0.80
M. S. Co-efficient	0.983
Power (Indicated)	4,500 h.p.
Power (shaft)	about 3,500 h.p.
Fuel-capac. (incl 57 tons in settling tank)	1,343 tons
Deep tank (for dry cargo or water ballast)	994 tons
Cubic-capacity of deep tank	34,770 cu. ft.
Hold capacity	520,550 cu. ft.
Total cubic capacity for cargo below decks	555,320 cu. ft. (bales)
Propellers (bronze twin four-bladed)	13'6" dia. by 11'9" pt.
Propelling engines	Burmeister & Wain 6 cylinder-four cycle
Cylinder bore	740 mm (29⅛")
Piston Stroke	1150 mm (45¼")
Engine speed (designed)	115 R.P.M.
Draft on trials—Consumption trial	13'0½" (fresh water)
Duration of Trials	6 hrs.
Total power developed (English)	4334.5 i.h.p.
Total power developed (Continental)	4275 i.h.p.
Mean Revolutions	113.30 per Min.
Port engine	112.72 per Min.
Stbd. engine	113.88 per Min.
Mean indicated pressure	82.2 lb.
Total number engine-room crew	14 men.
Full Ahead to Full Astern	32 Seconds
Daily fuel consumption in port	¾ ton
Daily fuel consumption at sea	13 to 14 tons

THE SPEED TRIALS

(Mean of 3 Runs over Mile)

Speed averaged	12.592 knots
Indicated horse-power (Continental)	4,756 h.p.
Indicated horse-power (English)	4,690 h.p.
Revolutions	121.23 P.M.
Propeller-Slip	10.6%
Mean indicated pressure	84.6 lbs.
Maximum i.h.p. attained over one mile	4848 (Cont.)
Maximum i.h.p. attained over one mile	4780 (Engl)
Maximum Revolutions	122 P.M.

It is to be noted that the contract stipulated that over 6 per cent of the designed revolutions of 115 per minute was not to be exceeded.



The Shipping Board's Diesel-driven motorship "William Penn," 12,375 tons d.w., and 4,500 i.h.p.

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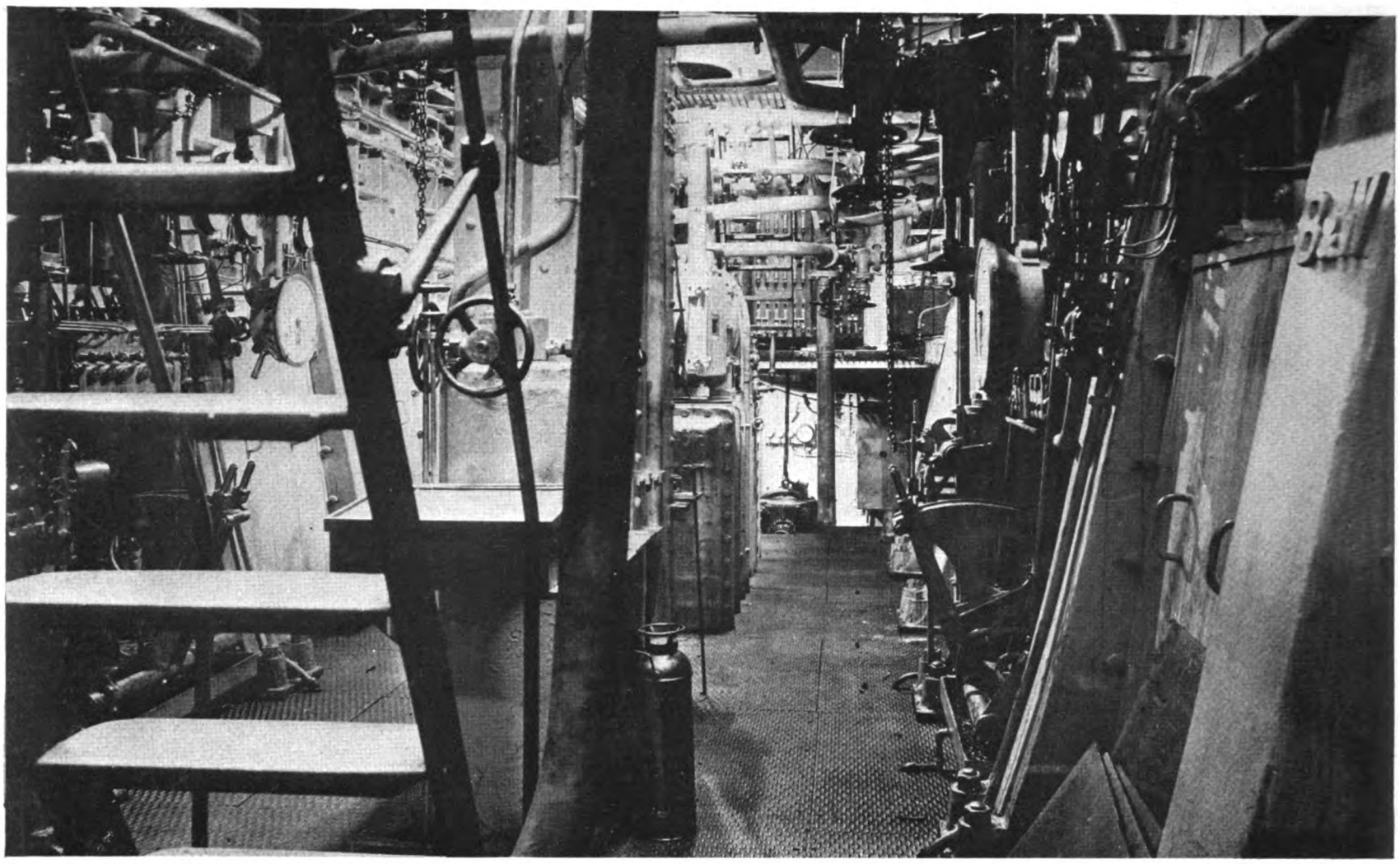


M. S. "William Penn." View from after end of control-floor between the two 2,250 i.h.p. main Diesel-engines.

On the six hours' run a total of 3½ tons (7,918.24 lbs. to be exact) of 28 degrees Baumé fuel-oil was consumed, including for a 100 b.h.p. Diesel-engine driving a 65 K.W. electric-generator carrying an actual load of 55 k.w.

In order to bring her down in the water as far as possible, about 1,250 tons of 30 degrees Baumé fuel oil was pumped into her double-bottoms and tanks. This oil was supplied by the Atlantic Refining Co. of Philadelphia to the Shipping Board and cost 4.8 cents per gallon. This price figures out at $14.11 per ton, or practically the same as the cost of boiler-oil to-day. Only under unusual circumstances will she need to take as much oil at one time, because this quantity will drive her nearly 30,000 miles at 10½ knots loaded.

The hull of the "William Penn" was originally designed as a steamer of lower power, and has very full lines, her block-co-efficient being 0.80, consequently her present Diesel-engines are of too high power to give the best operating economy. Although no doubt she would attain an average of 11½ knots loaded with full power of 4,500 i.h.p. on a daily-consumption of 14 tons of fuel, the Cramp Company believe it will be best to propel her at 11 knots, which she will attain when developing 4,000 i.h.p. on a daily consumption of 13¼ tons.

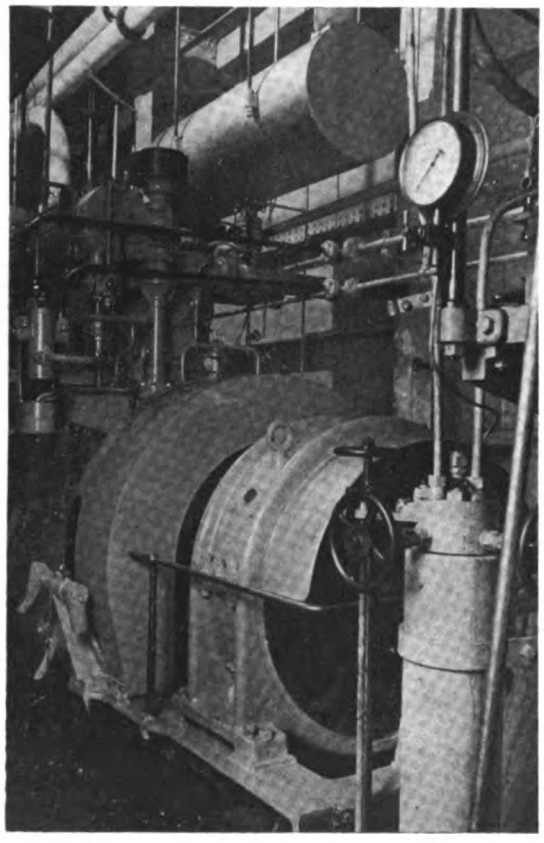
On the trials vacuum D.T.E. heavy lubricating-oil was used for the general working parts of the main engines, and D.T.E. extra-heavy for the working-cylinders, and D. T. E. for the air-compressors.

Comparisons of her operation in service will be made against the Shipping Board's turbine-electric ship "Eclipse" also trading on the same route. While we have no doubt as to what will be the outcome, we point-out that the comparison is not a fair one, because the "Eclipse" is a much finer-lined vessel and was designed to average 10 knots with 3,000 shaft h.p. She is longer, less beam and has a better block co-efficient. Her dimensions are as follows:

Turbine-Electric Steamer "Eclipse"

Length (O.A.)	457'6"
Length (B.P.)	440'1½"
Breadth	56'0"
Draught	28'7"
Deadweight capacity	11,867 tons
Total cubic-capacity of cargo	526,420 cu. ft. (bales)

Thus it will be noted that the steamer "Eclipse" is two feet longer over-all, but four feet shorter b.p. than the motorship "William Penn," and has four feet less breadth. Nevertheless, we feel confident that the "William Penn" will maintain at least one mile per hour better round-voyage speed (light and loaded), and the S. S. "Eclipse" will have nearly three hundred per cent (300%) greater fuel-consumption, while the "William Penn" will be able to carry about 10% more dead-weight cargo. This means a triple advantage, so the results will be most interesting when available. The "William Penn" has 29,000 cubic feet additional cubic-capacity for cargo below decks. Also it has only to carry 77 tons of fresh water, compared with 263 tons for the "Eclipse." Here also is a distinct gain.



M. S. "William Penn," Auxiliary Diesel generating-set at aft end of port side of engine-room.

It is up to the new Board, when appointed, to make the best ships of their fleet thoroughly modern by installing Diesel power, and furnish the remainder as targets on the Pacific and Atlantic Coasts for our navy, writing off their cost as a war loss.

The advantage of this would be enormous, and regardless of other conditions such as higher cost of construction and higher wages, America then could compete against the world.

Just at the moment we have before us some figures regarding the speeds of six steam-driven sister-ships, the hulls of which were built at the same yard as the "William Penn."

These steamers are as follows:

Mean Trial Speeds of Six Steam-driven Hulls Built at Same Yard

Type of Ship	Power	Revolutions	Mean Speed (Knots)
Geared-turbine	3,000 s.h.p.	70.2 90.2	7.7
4-cyl. quad	3,600 i.h.p.	76	10.6
Geared-turbine	2,750 s.h.p.	90.6 85.7	10.5
Geared-turbine	2,750 s.h.p.	90.4 88.6	7.7
Geared-turbine	2,750 s.h.p.	91.9 90.6	9.8
4-cyl. quad	3,600 i.h.p.	77.0	10.8

The above results, when compared with the 12.6 knots mean speed attained by the motorship "Wm. Penn," which had a greater trial displacement, and with the hundreds of foreign motorships that have visited our harbors carrying away American products, many of which have been in service for nearly ten years, will justify the remarks we have made regarding cargo steamers being practically obsolete to-day. It is pleasing that Admiral Benson has fully realized this situation, and has strongly recommended the conversion of many vessels. Unfortunately, his hands are more or less tied.

The "William Penn" will have been a very expensive vessel, owing to her engines having been purchased during the war with its high prices, and because a considerable number of structural

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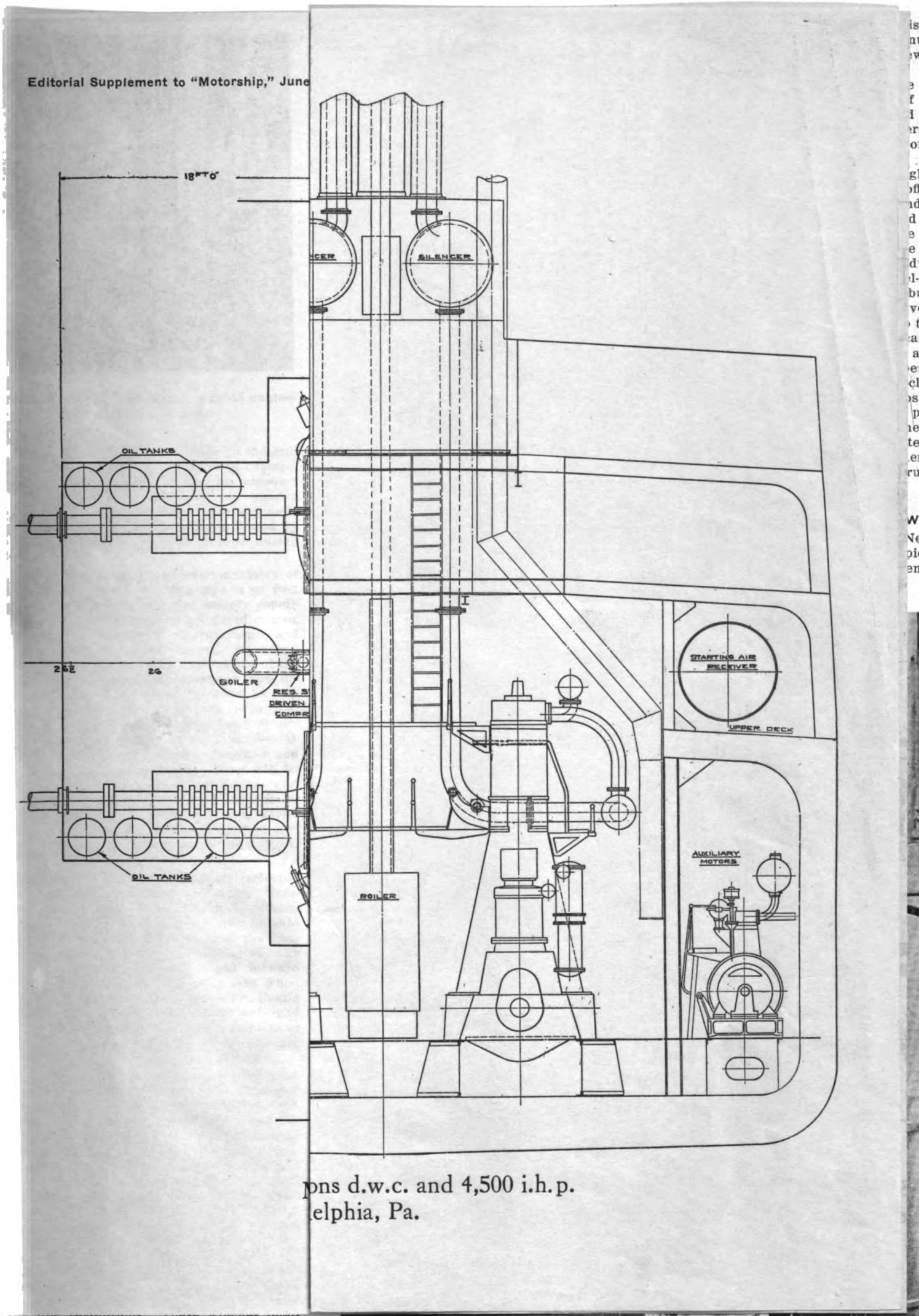
Editorial Supplement to "Motorship," June



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ate at 150 ft. per minute when lifting 2½ tons (5,000 lbs.) on the first gear, or 10,000 lbs. at 75 ft. per minute on the second gear. There is one warping-gear in addition, also equipped with a Westinghouse motor. The control-panels throughout the ship are Westinghouse, but are of a land type, and not of the maker's latest marine-model.

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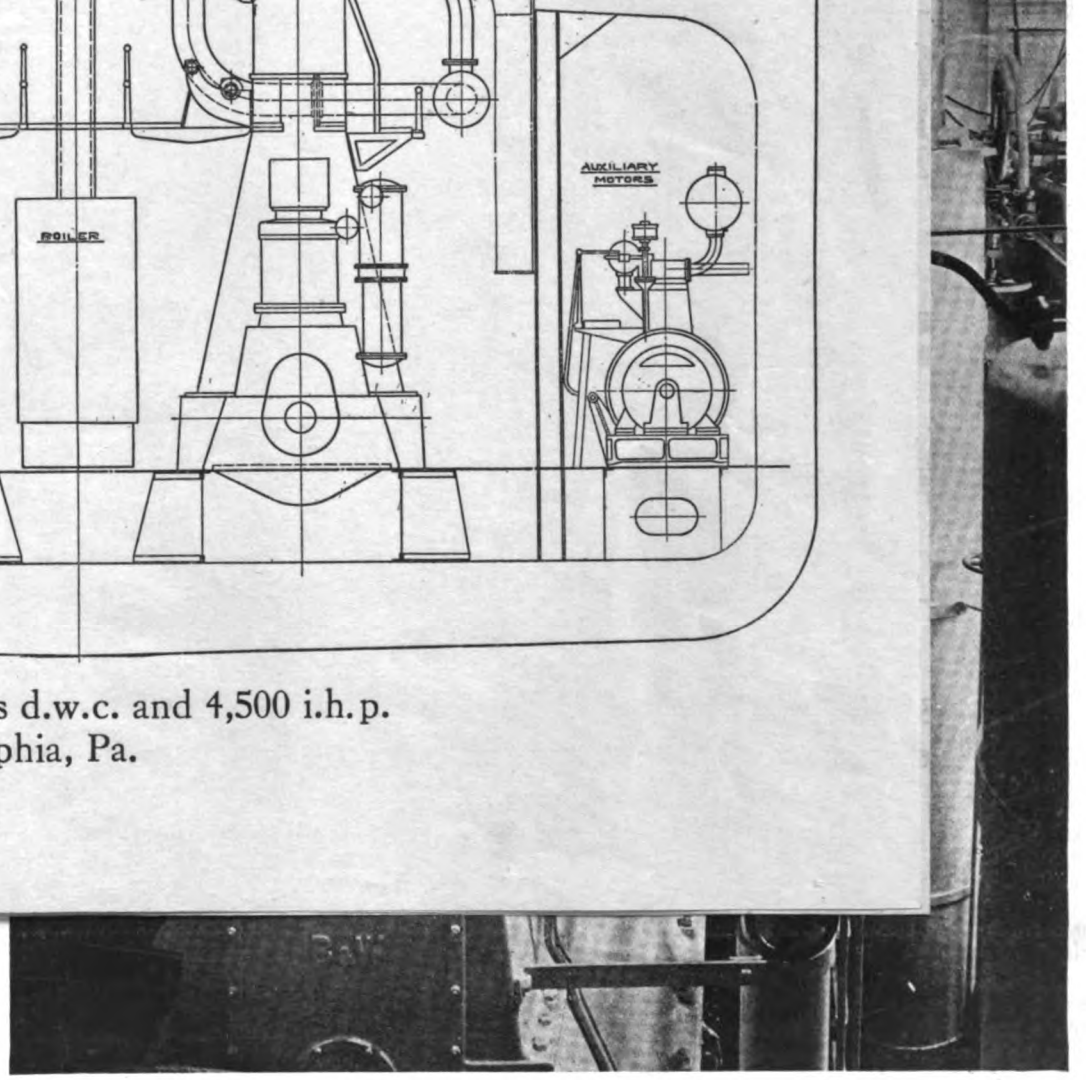

M. S. "William Penn." The three auxiliary Diesel-electric generating sets on the portside

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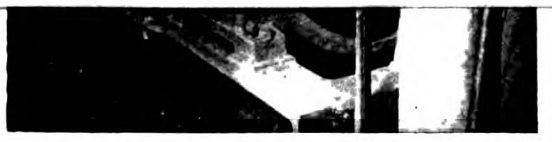

M. S. "William Penn," Auxiliary Diesel generating-set at aft end of port side of engine-room.

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The "William Penn" will have been a very expensive vessel, owing to her engines having been purchased during the war with its high prices, and because a considerable number of structural

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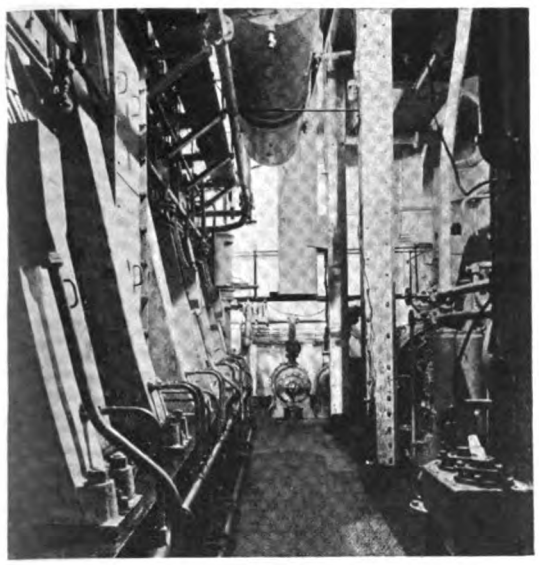


M. S. "William Penn." Starboard side of engine-room, looking forward.

changes and additions had to be made to the hull after her delivery from Pusey & Jones to Cramps. Consequently, half her cost should be wiped-off and the "William Penn" started on her maiden voyage to Java with a clean sheet. We will mention that her Diesel machinery was purchased by Mr. Edward N. Hurley when in Europe during the war.

Generally speaking, the propelling-machinery of the Burmeister & Wain type motorsips is so well standardized that descriptions are merely repetitions of previous installations, although, of course, there have been a number of improvements and modifications since the initial vessel, "Selandia." The "William Penn's" two main engines are of the regular four-cycle single-acting crosshead type, designed to develop 4,500 i.h.p. together at 115 r.p.m., and are direct-coupled to twin 14-in. dia. propeller-shafts via the old-type horseshoe thrust. They drive bronze propellers 13 ft. 6 in. dia. by 11 ft. 9 in. pitch, with four blades, designed and cast by Cramps for 11 knots speed. They will be in charge of Chief-Engineer Oscar Olson, and Oscar Mattsson, ex-Chief-Engineer of the motorship "George Washington," will go as guarantee-engineer for the Cramp shipyard for the first voyage. The vessel is in command of Capt. J. A. Meech.

All the engineers are old steam-men selected from the American-Hawaiian Steamship Company's fleet of steamers. This includes Mr. Olson, who has been in the Cramp shops for several months, and is therefore familiar with the construction as well as the operation of the engines. This follows the policy put forward many times by "Motorship," namely, that when a motorship is ordered, the shipowner should select several of his best steam men, and send them to the engine-builders' works and bring them up with the engines, which is the practice adopted with success by European owners.

The engine-room arrangements also follow the most recent standardized practice, with three 100 b.h.p. Diesel-engines driving electric-generators, two being for use in port and one being a reserve. At sea only one engine is run. The generators were built by Thomas B. Thrige, of Odense, Denmark, and this is the first time we have seen this particular mark on a B. & W. vessel, although it is used on many Werkspoor vessels. The usual B. & W. practice is to instal generators built by the Almanna Svenska (Swedish General Electric Co.) These generators furnish current for the engine-room and deck auxiliary machinery, including for 10 cargo-winches built by the American Engineering Co. of Philadelphia, and equipped with 30 b.h.p. Westinghouse motors, especially wound for low revolutions. These winches operate at 150 ft. per minute when lifting 2½ tons (5,000 lbs.) on the first gear, or 10,000 lbs. at 75 ft. per minute on the second gear. There is one warping-gear in addition, also equipped with a Westinghouse motor. The control-panels throughout the ship are Westinghouse, but are of a land type, and not of the maker's latest marine-model.

Reference to the plans will show that the three auxiliary Diesel engines are arranged on the port side of the engine-room, while on the starboard side are the electrically-driven bilge, sanitary, and piston-cooling pumps; the electrically-driven maneuvring air-compressor, the motor for which is also supplied by the Thrige Company; bilge and ballast pump, and the cooling-water pumps. At the forward end of the starboard side of the engine-room is arranged an electrically-driven lathe made by the Philip Smith Manufacturing Company, of Sidney, Ohio, and a drill-press supplied by the Champion Blower & Forge Company, of Lancaster, Pa.

Between the thrusts at the after end of the engine-room is a small oil-fired water-tube boiler for steam-heating the ship, and which will also supply steam in case of need to a small reserve air-compressor.

Between the main engines at the forward end there is an innovation; namely, a fresh-water cooling-tank and pump. Sea-water is used for cooling the air-compressors and the pistons of the main engines, but fresh-water is used for circulating around the liners and cylinder-heads. This is in accordance with the latest B. & W. practice, as with some makes of Diesel-engines fresh-water is used for the pistons and salt-water for the cylinder liners and heads. The B. & W. designs regard it as an extra precaution against mud deposits in the water spaces of the liners and heads when navigating in harbors and rivers with deep draft vessels.

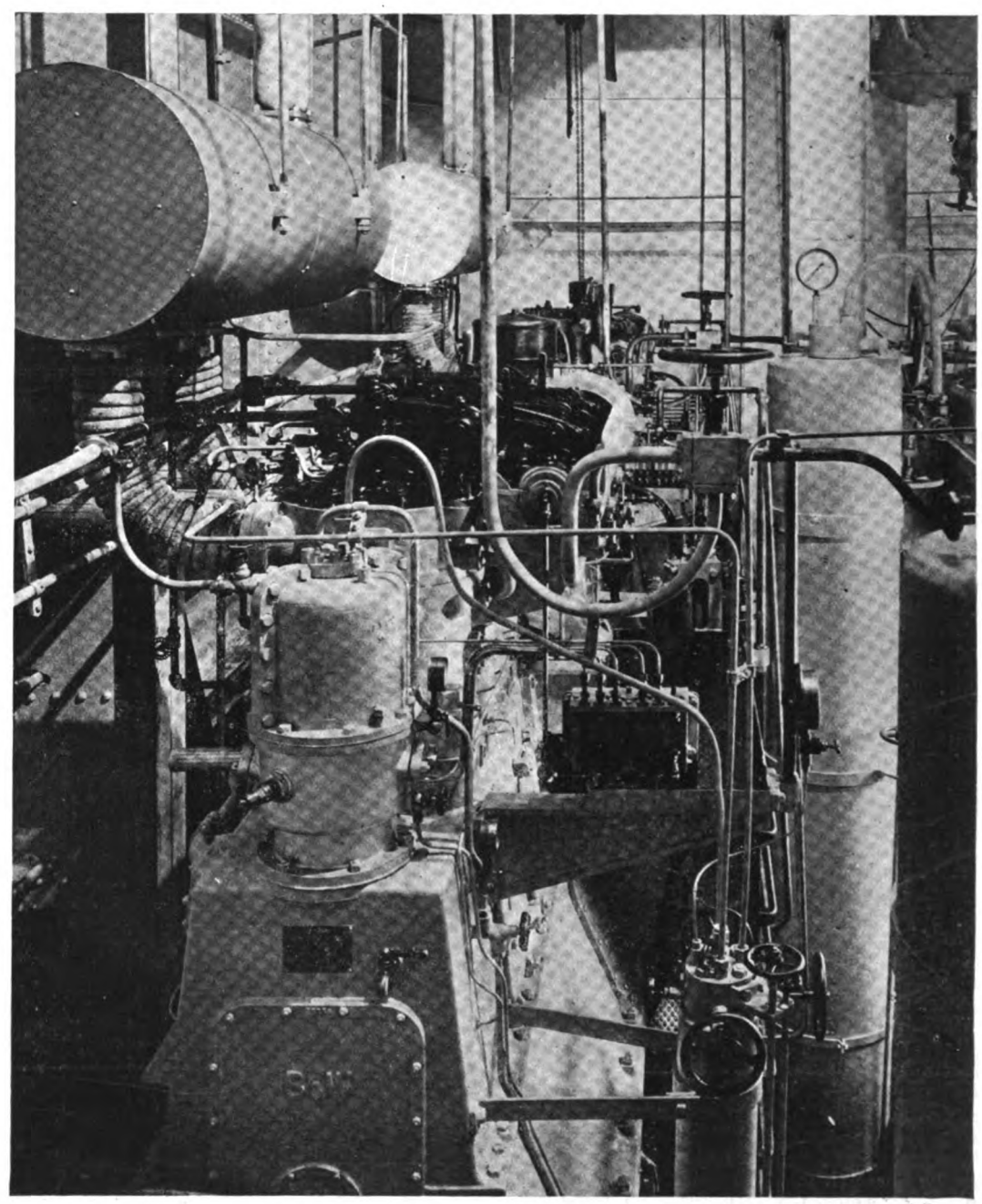
Referring to other equipment on this vessel, there is a Brunswick refrigerator-set driven by a Diehl 5 h.p. motor for supplying ice-water and for cooling the ship's stores, for the use of the crew, no passengers being carried on this vessel.

A number of chemical fire-extinguishers are carried, and these are of a type manufactured by S. F. Hayward & Company, of New York City. The engine-room telegraphs were supplied by Chas. Cory of New York, and the binnacle by John I. Hand & Sons Company, of Haddenfield, N. J. A wireless outfit is fitted, and this consists of a 2 K.W. set made by the Federal Telegraph Co. of Palo Alto, Calif., with a De Forrest control-box.

Discussing the question of the high cost of the "William Penn" with the Cramp officials, which as mentioned was due to the conditions under which the ship was constructed and to the large number of alterations that had to be made in conjunction with the installations, we are advised that it would cost 10% more per deadweight-capacity ton to build a similar sized Diesel-driven vessel to-day at the Cramp Yard than to build a steam-driven vessel of similar size. However, if it came to the question of the cost of the two types of ships the motor-vessel could be built to carry the same amount of cargo as the steamer at approximately the same cost, because she could be made ten to twelve per cent smaller over-all, including power. This would reduce her complete cost, and at the same time would reduce the cost per net-cargo-capacity-ton to practically the same as the cost per net-cargo-capacity-ton of the steamsip. This shipowners should bear in mind when figuring-out the cost of new motorship construction at the present time.

MR. CALCOTT'S ADDRESS WANTED

Will Mr. D. S. Calcott, late of Newport News, send us his present address, as copies of "Motorship" recently mailed him have been returned by the Post Office.



M. S. "William Penn." The three auxiliary Diesel-electric generating sets on the portside

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By OUR SPECIAL COMMISSIONER

Part III.—Business Aspects and the Systematization of Canal Traffic. Accomplishments and Prospects.

OUR investigations bring out in striking relief the known fact that the resources of commerce and industry which are tapped by the New York State Barge Canal are staggering in their wealth and vastness. At one end of this magnificent transportation route is Buffalo, the converging point for an industrial traffic that originates in the heart of the richest country in the world and at the other end is situated New York City, whose towering eminence as a seaport long ago ceased to be disputed. The pressure of traffic between these centers is enormous.

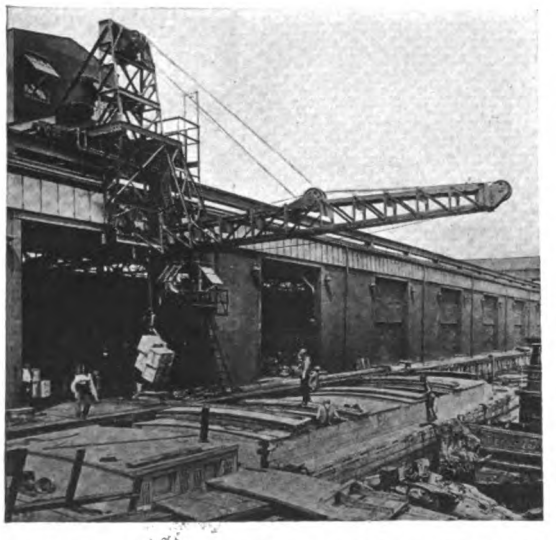
Modern industry and transportation are complementary and inseparable. Because of the division of labor and the specialization of functions, a high degree of fluidity in the processes of interchange and assortment is absolutely essential; conversely, also, freedom of movement and efficient traffic facilities foster industrial development. It is significant, therefore, that the two great commercial centers, Buffalo and New York City, are located at the termini of two of the world's most comprehensive and efficient transportation systems—the Great Lakes and Ocean shipping.

This strategic location of Buffalo is reflected in her diversified and voluminous industries, an adequate recital of which would take us far afield from the scope of this article. Her grain elevator capacity exceeds 28,000,000 bushels and her output of flour is more than 5,000,000 barrels yearly. One concern turns out 21,000 barrels a day. 2,000,000 tons of steel products are turned out annually and the coal required for this and fifty-eight per cent of all the different industries enumerated in the U. S. Census amounts to more than 15,000,000 tons.

Just as Buffalo forms the clearing-house between raw products and manufactured articles, so New York City is the clearing-house between manufactured products and foreign commerce. The assessed real-estate value of this great harbor city exceeds $8,000,000,000, more than two-thirds the value of the remainder of the State of New York. Practically every business enterprise in the entire United States has headquarters or at least some form of permanent representation in New York City.

Although it would be difficult to overemphasize the great importance of all the transportation systems that link-up these great centers, it must be borne in mind also that the intervening strict, of which the transportation route is a eritable backbone, teems with commercial and industrial activity. The warp and woof of it is interwoven with the innumerable strands of traffic that tie New York and Buffalo together.

The growth of this great complex of human activity was originally and basically due to water transportation along the Hudson, and in the valley of the Mohawk. So stupendous and rapid was the development that not only one but several parallel railroads along this same route came into being and to this day the full demand for traffic facilities of any and all kinds are far from being met. Nothing could be further from the truth than to suppose that there is anything of a mutually exclusive nature as between railroads and waterways. The fact that canal and rail transportation figures have until recently borne an inverse ratio to one another is not founded on necessity or on any intrinsic circumstances, but on fortuitous and accidental conditions.



Close-up view of freight-handling machinery at Pier 6, East River, New York City

Whereas it has been customary in dealing with this subject to lay much stress on the comparative rates of rail and water transportation, we shall note merely in passing that they have in the past favored canal traffic in the ratio of between two and three to one and shall urge a much broader consideration of the matter. The vital relation which transportation bears to industry consists in the high degree of specialization which is practised and which calls for continuous re-arrangement and re-assortment of products over the length and breadth not only of an industrial district, but of the whole world. In the devious path that leads from the origin of production to the destination of consumption, nearly every stretch of the journey is accompanied by a change in the ownership of the product, by the modifications of technical processes, and by re-classification for marketing.

An early philosopher conceived society and its organization as a great body; if he had lived today he would undoubtedly have called transportation its life-blood. Regularity and certainty of its circulation transcend in importance every other characteristic that it may possess.

The history of railroading shows that the criterion of co-ordination and dependability has not been fully met and it is not being met now. In the early days, we had wild-cat lines, rate-wars, and an overdose of those things which are evil in our competitive system. Railroads are what are known as natural monopolies and we are far from knowing how to handle them. Unregulated competition has been found to be most inimical to the development of that feature of transportation which we have seen to be its most vital one—stability. Although government regulation has been worked-out on an elaborate scale through the Interstate Commerce Commission and even government ownership resorted to, a solution is still far off. There has never been a time when it could be said that the railroad system was in working order.

It is the waterways that are bringing a solution of their own into sight and the field in which this happy development will manifest itself will be the industrial area served by the New York State Barge Canal.

It possesses a strategic advantage in not being a natural monopoly. For one thing it is State-owned and can be offered on like terms to all. Almost an unlimited number of individual lines can be operated on it simultaneously; boats can

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pass each other in the same or in opposite directions without the iron-bound limitations of railway schedules and all that that implies of unitary management. Although the lines will be parallel, they will not suffer in any way, shape, or manner from the evils of parallel-line competition such as have been known in railroading. Paradoxical though it may seem, this very freedom of competition is the very thing that will give the desired results, because, as we shall see in what follows, it has the same characteristics as the ordinary business relations of other industries upon which American business success is founded.

Some of our great corporations have already begun to fall in line with this development. The Standard Oil Company is developing its own Barge Canal transportation service in the same elaborate and thorough manner with which they do everything else. Besides building a private boat-landing on the new Canal near their supply depot in Rochester at a cost of $100,000, their remaining investments in Canal transportation run into the millions. Although the use which they made during the first opening of the Canal in 1918 may be considered experimental, it amounted even then to 16,000 tons of fluids. Nevertheless, this is probably only a straw which shows how the wind will blow: the 1919 season showed almost a threefold increase in tonnage transported, or 46,000 tons and this was doubled in 1920. The Standard Oil Company is now using or has on order a total of 16 of their own tank-barges specifically designed for tank transportation on the New York State Barge Canal.

Each of the boats is 148 ft., 9 in. long, has a depth of 11 ft., 10 in. and a beam of 28 ft.; the net cargo-capacity is 788 tons. Since the motive power is a 300-H.P. Standard gasoline engine, the fleet marks the first and most significant use of the internal-combustion engine on the Canal. In view of this oil traffic, fuel should always be available for canal motor-vessels.

The General Electric Company, who operate a huge plant at Schenectady on the Barge Canal, has also given an emphatic endorsement of this magnificent waterway. When the Canal was opened in the Spring of 1918, they prepared a harbor of their own and secured three barges and a tug. The barges are of wood, well-built and substantial. They average 125 ft. in length, have a 26-ft. beam, and a fully loaded draught of 10½ ft. Since each boat carries 350 tons, the combined capacity of the fleet exceeds 1,000 tons and with it they made five round trips during the first season and hauled 4,100 tons of freight valued at $2,000,000. At the end of their 1920 season they had increased the use of their fleet to the extent of hauling 22,000 tons for a total distance of 12,000 miles in 30 round trips covering a period of 7 months. The value of the material hauled is being kept confidential.

The motive power for the General Electric Company's fleet is a wooden tug having a length of 81 ft. and displacing 70 tons. It is driven by a 240-H.P. steam-engine and requires 7 tons of coal per day. Owing to the fact that part of the coal is obtained under contract at $5 per ton while some of it is bought at spot prices as high as $15, the fuel-cost of the tug is indefinite, but it is safe to say that it does not come to much less than $50 per day. A Diesel-engined tug which we hope soon to be permitted to describe, and which develops 225-H.P. would meet the General Electric Company's needs and would require a daily outlay for fuel of less than $10 per day.

These great companies naturally arrange these private services to suit themselves and they have no special problems of organization to cope with. Because of the fact, however, that there are not many such, who have enough traffic of their own to make it worth while for them to provide their own transportation, the full possibilities of the Canal can be realized only if an extensive common-carrier service is also established. This is where comprehensive organization will come in. With some notable exceptions, of which we shall treat presently, the only common-carrier service that has been offered in the past has been that of the individual boat owner or charterer, here today and gone to-morrow. We have seen how important it is that transportation service be regular and dependable. If these individual boatmen had carried cargoes free-of-charge, it is doubtful if they would have done much to increase traffic on the Canal, because the cost of transportation is entirely secondary to its dependability.

One of the exceptions referred to is the Inland Marine Corporation, formerly Shippers Navigation Company, financed by Syracuse capital. Although they have not organized regular schedules for barge trips, and have contracted for cargoes merely as they became available, they have rendered service in a business-like manner. As they had contracts practically to the full extent of their capacity during the entire season of 1919, their operations were most successful. According to available reports, their 1920 operations left nothing to be desired. Their large resources in equipment, which consists of fifty 240-ton Erie Canal barges and nine cargo-steamers and which enable them to contract for service on a large and well organized scale, account for their success even more than the low rates which they charged. Needless to say, they can make themselves a handsome present in the way of additional profits by using economical oil-engine propulsion and cutting thousands of dollars off their fuel-bills.

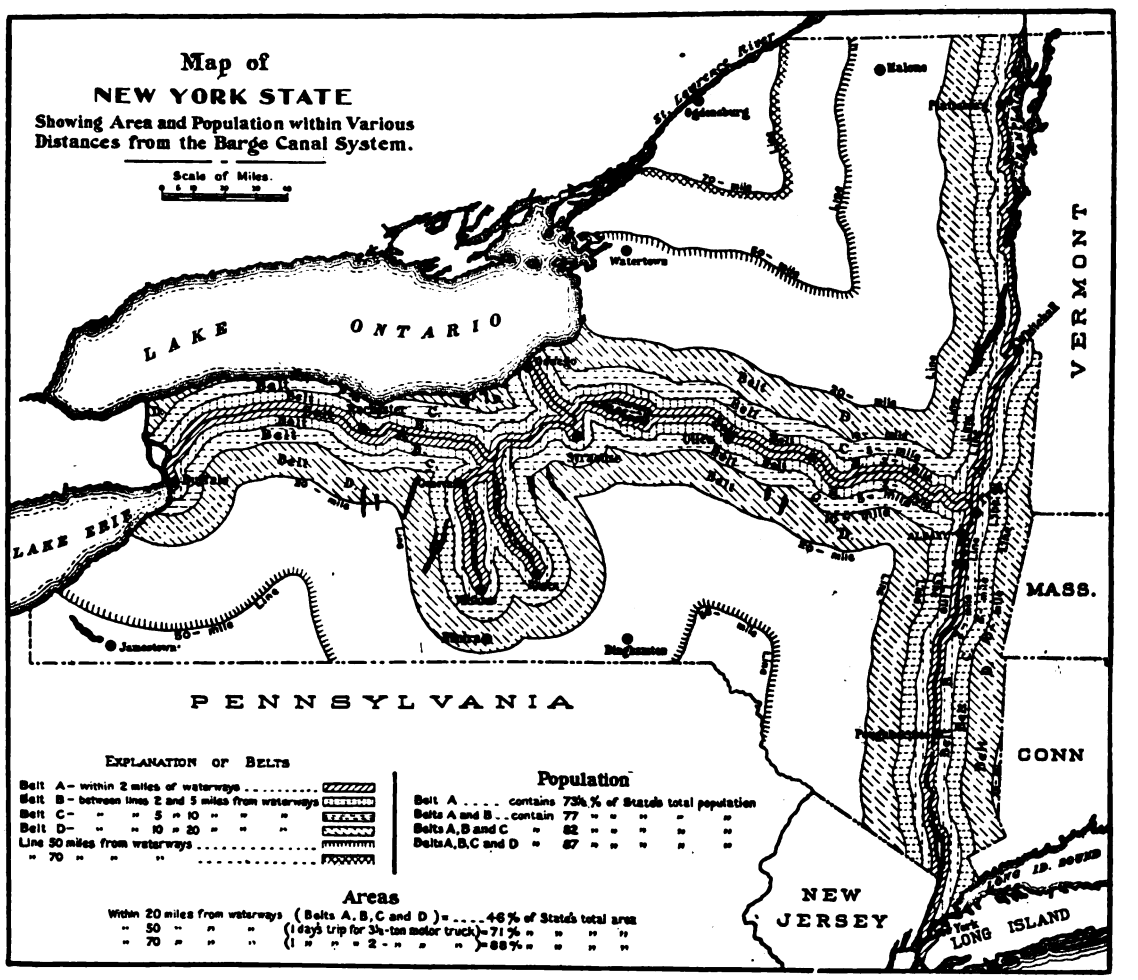
What may be called a specialized common-carrier service is offered by the Ore Carrying Corporation. They concentrate almost exclusively on the transportation of quarry products originating on the shores of Lake Champlain. With their fleet of 60 barges they transported 132,128 tons of iron-ore in 1920, an increase of practically 200% over their 1919 business.

A common-carrier service about which a great many misconceptions have been spread abroad was that offered by the United States Railroad Administration and subsequently the Inland and Coastwise Service of the War Department. The officials who had charge of this work were confronted with three formidable sets of difficulties: namely—building and putting into service newly designed equipment, inherent governmental inefficiency, and the chaos of post-war conditions. Although this transportation enterprise was undertaken theoretically in order to blaze the way for private initiative, its poor showing, entirely excusable though it was, certainly could not have produced that result. More serious even than this was the unhappy psychological effect produced on the minds of prospective shippers by the likelihood that they might be put in the position of competing with the United States Government. Actually, independent operators had no difficulty in taking business away from the Government, as is shown by the fact that independent lines carried as much as 75% of their capacity, whereas the government boats carried only 16%. The Government charged absurdly high rates, lost business and incurred heavy deficits. Nevertheless, unsympathetic interests played up "government competition" so effectively that they succeeded in preventing a certain amount of business from coming to the Canal. Many people seriously believed that service such as that offered by the Government could compete with private enterprise, but we have yet to learn of a single authentic case in which its officials did any rate slashing.

With bids recently opened to private parties for the government equipment, the episode may be considered closed. Anything like sufficient experience with the barges to permit an estimate of their merits, simply does not exist. All that can be said now is that some very expensive boats are to be had cheap and could be converted to more economical motor power, and that one more opportunity is being presented favorably situated parties to benefit at the expense of taxpayers. It is very much to be hoped that somebody will benefit. We shall give a detailed description of the Government fleet in a later article.

In striking contrast with the Government's service has been the work done by the Transmarine Corporation of Port Newark, N. J., whose strategic geographical and business situation endow it with unusual qualifications for conceiving and executing a highly developed Canal Transportation service. It is one of the component companies of the Submarine Boat Corporation, whose other subsidiaries are the Electric Boat Company, the New London Ship and Engine Company, the Electro Dynamic Company, the Atlantic Port Railway, and the Newark Bay Shipyard. They are specialists in every branch of work that might enter into Canal transportation. They have their own shipyard and can design exactly the right kind of Canal craft with promptness and despatch. Association with the New London Ship and Engine Company makes available to them on excellent terms and short notice economical oil-motor power such as Canal operation will demand as the New London Co. builds Diesel engines of moderate power. But by far the most important aspect of Transmarine Service is the fact that it will be co-ordinated on a large and comprehensive scale with Ocean shipping, the nucleus of which is the fleet of 32 new steamers belonging to the Transmarine Corporation.

At Buffalo the Transmarine Line connects with the Great Lakes Transit Corporation for Duluth, Minneapolis, and St. Paul. Nightly schedules are


Map of
NEW YORK STATE
Showing Area and Population within Various Distances from the Barge Canal System.
Scale of Miles.
LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
VERMONT
MASS.
CONN
NEW JERSEY
LONG ISLAND
Explanation of Belts
Belt A– within 2 miles of waterways
Belt B– between lines 2 and 5 miles from waterways
Belt C– " " 5 " 10 " " "
Belt D– " " 10 " 20 " " "
Line 50 miles from waterways
" 70 " " "
Population
Belt A .... contains 73½ % of State's total population
Belts A and B .. contain 77 " " " " "
Belts A, B and C " 82 " " " " "
Belts A, B, C and D " 87 " " " " "
Areas
Within 20 miles from waterways (Belts A, B, C and D) = ... 46 % of State's total area
" 50 " " " (1 day's trip for 3½-ton motor truck) = 71 % " " "
" 70 " " " (1 " " = 2 - " " ") = 88 % " " "

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maintained from Buffalo to Detroit and Cleveland via the Buffalo Transit Company (C. & B.) and the Detroit and Cleveland (D. & B.) lines. We have here an admirable concrete example of a systematized water transportation that links up the Great Lakes region with the focus of Ocean commerce at New York City.

It need hardly be mentioned that the physical and floating equipment of the Transmarine Corporation is of a high order of excellence. Last year they placed in service eight 400-ton steel barges 100 ft. long with a beam of 22 ft. and 36 more are being made ready for service during the coming season. Elaborate freight-handling machinery for transferring cargo directly and with high economy from the barges to the holds of ships. It is a feature of signal importance, because handling charges are a large item in transportation and anything that can be done to reduce them yields a substantial increase in profits. Efficient freight handling, as thus exemplified, and as provided for in millions of dollars worth of barge terminals and grain elevators built by the state, will be a big factor in the success of the New Canal.

Although it is more than probable that the biggest immediate prospects for business on the Canal are for through shipments of bulk cargoes, a speedy pick-up of way traffic in package freight is to be expected as soon as regular and dependable through movements have demonstrated themselves to the shippers. Without exception, way traffic on every railroad of which there is any record exceeds through traffic and in some cases it amounts to as much as eighty percent. Farsighted recognition of this fact is embodied in the construction by the State of warehouse terminals in 44 of the 131 municipalities situated on the line of the Canal at an expense of something like $25,000,000. The appended map shows an estimate of what may be expected in the way of local traffic: it speaks for itself.

A consummate grasp of the situation which we have only been able to outline here is reflected in the formation of The Great Lakes, Hudson and Atlantic Waterways Association early in March. The moving spirit of this organization is the Transmarine Corporation, whose business-like attitude towards the Canal has already been commented on, and it comprises men interested in Canal affairs, traffic men representing various industries, as well as some large Ocean shipping companies. Its preliminary committee is headed by Dr. Henry Moskowitz, Industrial Consultant of the Transmarine Corporation as Chairman; W. W. Nicholson, President of the Inland Marine Corporation, operating 75 boats and barges; R. H. Barnwell, Vice-President, Barge Canal Freighting Corporation, operating 30 boats and barges; Samuel MacClurkan, Traffic Director of the Transmarine Line, operating 20 modern steel barges; A. Miller McDougall, McDougall-Duluth Shipbuilding Co., operating three 1600-ton self-propelled barges; Roy S. Smith, Executive Director of the Albany Chamber of Commerce; C. L. Ferguson, Traffic Manager, American Papeterie Co., of Albany; John G. Barry, General Sales Manager of the General Electric Co. of Schenectady; and C. J. Beck, Traffic Director of the United American Steamship Lines. Temporary headquarters are the National Marine League at 268 Pearl Street, New York City.

A preliminary statement, which will be amplified at a convention of the Association to be held in June, announces these three objects of the Association:

"(1) To bring about co-operation between shippers and water-carriers;

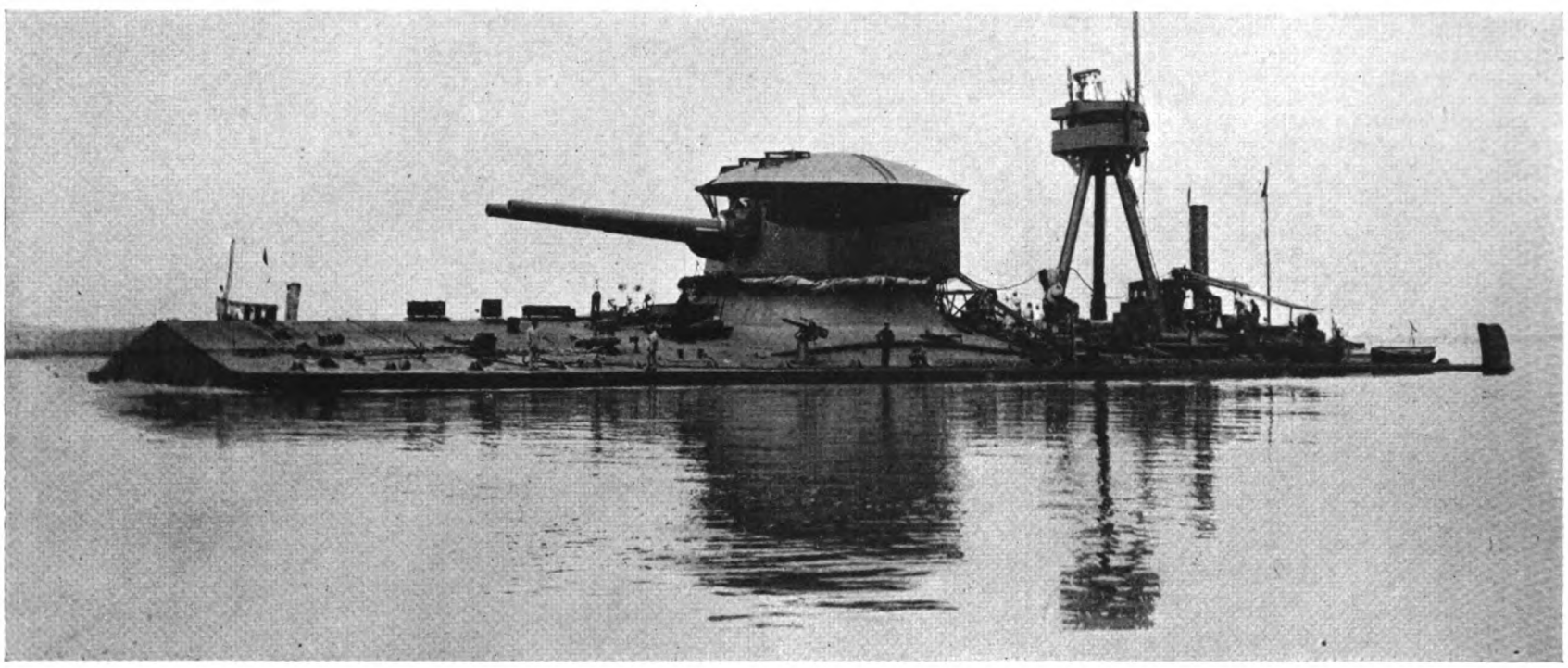
"(2) To co-ordinate the transportation facilities between the Middle West, Atlantic Seaboard and foreign ports, via existing American water routes and

"(3) To further waterway projects and port developments in the region embraced in its title, namely: the Great Lakes, Middle West, New England, and North Atlantic States."

There is little that we might add to this that could further emphasize the potentialities of the shipping industry on the New York State Barge Canal. In the very near future questions of floating equipment and motive power will come up for settlement and the purveyors of economical motor transportation will be presented with rich opportunities.

Before concluding this installment it is interesting to record that the first motor-vessel of the fleet now being constructed by the McDougall-Duluth Shipbuilding Company for the Inter Waterways Line Inc. left Duluth for Buffalo, N. Y., on the morning of May 20th, loaded with a cargo of oats. This vessel is propelled by Skandia surface-ignition type heavy-oil-engines.

(To be continued)



"Faa di Bruno," a floating-battery of the Royal Italian Navy, propelled by a Diesel oil-engine. She carries two 15-inch guns, two 14-pounders and two 1½-pounders. The stack is for the exhaust-gases. She and her sisters did deadly work against Austrian forts in 1918.
Photo courtesy of the Ministry of Marine

Lubricating-Oils for Diesel-Engine Air-Compressors

AT a recent meeting the Diesel Engine Users Assocation was quite unanimous on the point that whatever quality of lubricating-oil was used in the air-compressor, whether this be a straight-mineral-oil or a compounded-oil, the smallest practicable quantity should be introduced.

The following are the specifications regarding oils suitable for use for lubricating air-compressors which were finally adopted.

LUBRICATION

The lubricating-oil used in the air-compressor should be an oil of the highest-grade obtainable and must be used only in the *smallest practicable quantity.*

The following properties are necessary in all lubricating-oils for Diesel-engine compressors:

(a) The oil should be entirely free from suspended particles of water.

(b) The oil must be entirely free from sand or other inorganic material. No mechanical impurities must be visible in the oil when it is viewed by holding a sample in a glass vessel against a light.

(c) The oil must be entirely free from inorganic acids.

(d) Oils should not be lower in viscosity than 300 seconds Redwood at 70 degrees Fahrenheit nor higher in viscosity than 3,000 seconds Redwood at 70 degrees Fahrenheit.

(e) Oils should in no case be lower in closed flash point than 350 degrees Fahrenheit.

(f) If the oil is to be used on an enclosed crankcase high speed engine in which the same lubricant is used both for the compressor and in the crankcase, it should have a closed flash-point of not less than 400 degrees Fahrenheit. (It should be borne in mind that "Open" flash-point tests give results 20 degrees to 30 degrees Fahrenheit higher than the closed tests on these types of oils).

For further guidance it may be pointed out that from past experience it has been found that the oils which have met with most success in Diesel-engine air-compressor lubrication, besides complying with the foregoing stipulations, have generally possessed properties lying within the following limits:

Specific gravity .....0.870 to 0.915 at 15° C.
Viscosity (Redwood) .400 to 1,000 seconds at 70° F.
Viscosity (Redwood) ..75 to 125 seconds at 140° F.
Closed flash point .....Not less than 400° F.
Color.....Red or yellow by transmitted light, but clear (not misty or smoky).

Both straight mineral oils and compounded oils containing small quantities of saponifable oil have met with success on Diesel-engine compressor service, but the majority of successful oils have been straight mineral-oils.

FLEET OF MOTORSHIPS FOR NEW YORK

At the end of May quite a large fleet of motorships were in New York harbor, loading and unloading cargo. Included were the British 10,050 tons d.w. Vickers-Diesel-engined tankers "Seminole" and "Narragansett" of the Anglo-American Oil Co.; the Alaska Steamship Co.'s 6,500 tons McIntosh & Seymour Diesel-engined freighter "Kennecott"; the Swedish Götaverken-built 7,500 tons motor-freighter "Stureholm," and the German 17,000 tons d.w. tanker "Zoppot," fitted with Krupp Diesel-engines.

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MOTORSHIP

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WHAT'S ALL THE SHOOTIN' FOR?

Few of our readers who recently saw an amusing play in New York, realized that they were being fooled—delightfully perhaps—until just before the final curtain, although the key to the situation had been very subtly suggested by the constant repetition of the above and other similar remarks. To-day the curtain is dropping on the play on the stage of the theatre of shipowning and shipbuilding, which is very serious for both the actors and audience. Although they are not all yet ready to openly admit it, many shipowners and builders have been unconsciously taking part in a play which has become almost a tragedy. When the shipping boom was at its height, almost anything that would float would make money, with the result that most American shipowners wouldn't even consider the problem of developing and building types of cargo and passenger carriers that would effect economies of a few "paltry hundred-thousand dollars a year," and which would be able to keep the seas in the face of severe competition, so bright did the present and future of shipping then seem. For similar reasons few shipbuilders used technical pressure upon shipowners to build economical motorships, which in their own interests they should have done. The result everyone knows, and to-day our ships—and the uneconomical steamships of foreign countries—are having great difficulties to run on the high-seas without heavy loss, whereas, so far as we have been able to ascertain, only one ocean-going foreign motorship has been laid-up through inability to obtain cargo at terms which paid to run her, whereas thousands of steamers are tied-up and most motorships are working with full cargoes. Shipping men who sat in arm-chairs through the boom now realize "what all the shootin' was for," and why this publication has fought so hard for the adoption of oil-engine power for the last five years, and that in our pages we clearly indicated that a grave mistake was being made. There's one chance left for this play of the American Merchant Marine to become a success, namely, for it to be partly re-written to convert several hundred existing freighters and passenger-freighters to economical Diesel, or Diesel-electric power without further hesitation. The Shipping Board, as co-author of the unsuccessful play, must do its part in the revision. Will it be done before the final curtain rings down?

BRITISH MOTORSHIP CONSTRUCTION

Taking into consideration that during the war only one British firm was allowed to build Diesel-engined merchant-motorships for ocean-going traffic, the recent development of this new type of vessel has made remarkable progress in Great Britain since the Armistice and standardized-craft of 15,000 tons and 14 knots speed are now normal and regular products, with building periods and costs less than those of steamers per ton net cargo-capacity.

Lloyd's returns for British shipbuilding for the three months ending March 31, 1921, must be mortifying to those of our own shipyards, that missed the golden opportunity a short time ago. The list given elsewhere in this issue shows that on that date there were 66 motorships of approximately 418,639 d.w.c. tons on the ways in the British shipyards, of which thirty were between 5,000 and 10,000 tons gross-register each. The greatest activity is on the Clyde, where Harland & Wolff and other big yards are forcing the pace, there being no fewer than 27 motorships of 173,630 tons gross building at Glasgow, Govan, Greenock, Dumbarton and Dalmuir. Barrow is second on the list, with five vessels aggregating 34,445 tons gross. Contrasting with this comparative "boom" in motorship building, *steam*ship construction in Gt. Britain is in the same very depressed condition as the United States.

As has been illustrated in "Motorship," several big American shipbuilders recently turned their attentions to motorship construction, and a number are engaged in building one or more large Diesel engines; but the day of securing orders for large fleets of new motor-freighters is not yet with us again, and will not be until the world's business conditions take an upward trend. So our shipyards will do wisely if they follow the example of the Merchant Shipbuilding Corporation and prepare their facilities for the conversion of existing steamers to Diesel motor power, and urge upon shipowners to have this done. Otherwise many additional shipyards will close down before long.

MOTORSHIP CONSTRUCTION IN GERMANY

Realizing the great importance of economy in connection with the re-construction of Germany's merchant marine, her shipbuilders and ship-owners during the last twelve months have very actively taken-up the construction of Diesel-driven motorships. One new shipyard alone has devoted practically its entire production to this class of vessel, and has 19 ways ranging from 140 ft. to 820 ft. on a river frontage of 6,000 ft., and has 6,000 employees engaged. Also 1,500 more employees are to be added. We refer to the Deutsche Werft at Hamburg, which, as already announced in "Motorship," is constructing a fleet of freighters in which will be installed Burmeister & Wain type Diesel-engines now building under license by the A.E.G. In this project the Hamburg American Line are financially interested. Krupps of Kiel are also building a large fleet of Diesel-driven motorships, and their plans were outlined in our pages by the Chief-Engineer some months ago. Blohm & Voss of Hamburg, who for many years have worked hard on developing a double-acting Diesel engine, are now completing a new ship equipped with engines of this type and have just received an order for eight motorships from the Hamburg-American Line. Then again the Howaldtswerke of Kiel are constructing two motorships in which Sulzer-type Diesel-engines are being installed. Meanwhile America looks on, but does very little.

FIFTH TURBINE-ELECTRIC FREIGHTER ORDERED

A contract to convert the 11,800 tons steam-driven freighter "Victorias" has just been placed by the United States Shipping Board, and she is the fifth of twelve vessels to be thus changed. In an article on other pages in this issue are given details of the Shipping Board's solitary motorship, the machinery for which was ordered about three years ago, and which has been in this country for nearly two years. As yet the Shipping Board has not ordered the conversion of a single steamship to economical Diesel power or to Diesel-electric drive, but seems to have plenty of money for converting steamers from one class of steam-machinery to another type of steam-drive. We draw the attention of the Board to Lloyd's returns of motorships launched in the world (exclusive of Germany) during 1920 and 1921, as follows:

1920		1921	
No. of Ships	Gross Tonnage	No. of Ships	Gross Tonnage
100	189,977	194	503,844

Total for two years, 294 motorships of 693,821 gross tons

This represents approximately one-million tons deadweight, and the advance in tonnage between 1920 and 1921 is most noteworthy. The turbine-electric-driven vessel absolutely cannot compete against Diesel motorships on the same routes.

INTERNATIONAL SURFACE-IGNITION OIL-ENGINE TESTS

American surface-ignition oil-engine manufacturers should seriously consider sending an engine to France for the series of tests to be run in October next under the supervision of the Technical Commission of the Automible Club of France, the Agricultural Commission, the Legue Maritime Francais, and the yachting division of the Automobile Club of France. Any engine of this type suitable for fishing-boats or agricultural purposes can be entered by firms in America, France, Great Britain, Denmark, Belgium, Holland, Norway, Sweden and Switzerland. Powers range from 2½ to 50 b.h.p. In the 35 b.h.p. to 50 b.h.p. units, the engine must have two cylinders. Powers must be developed at speed ranging from 450 to 300 r.p.m., respectively, with 20 per cent allowance over or under. All engines must be ready and in France by October 15th, and entries must be made by August 1st, the entry fees varying from 200 to 400 francs, according to power. Full details regarding the trials can be secured from the Commission Technique de L'Automobile Club de France, 8 Place de La Concorde, Paris. In view of the recent big financial grants made by the French Government to encourage the adoption of oil-engines in fishing-vessels, it would at least be well-worth the while of American manufacturers making full investigations, with a view to entering an engine for the trials and establishing selling agencies in France.

OUR CONTEMPORARY ERRS

Recently we stated that Harland & Wolff were building a duplicate of the 14,000-ton 12½ knots Diesel motorship "Glenogle" of the Glen to the order of the Holland-American Line. In its issue of May 7, 1921, "Nauticus," of New York, states that this report is without foundation. We beg to contradict our esteemed contemporary, as we have the information direct from Harland & Wolff. Furthermore, the Holland-American Line's directorate has advised our Netherland correspondent that two such motorships are on order with Harland & Wolff, but that they are not yet named. The report that the "Statendam" was to be Diesel-engined (not published in "Motorship") was due to an error on the part of the head of the New York office of the Holland-American Line.

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Single-Screw Motorship "Sardinia" Runs Trials

First of the 2,140 i.h.p. Werkspoor-Diesel Engines Exceeds Anticipation in New Freighters for Otto Thoresen Line.—Three American Companies at Work on Similar-Powered Engines of Modified Werkspoor Design

THREE American shipbuilding and engineering firms are each now engaged in producing a modified Werkspoor-Diesel marine-engine of 2,140 i.h.p. under the supervision of experts from the licensors in Amsterdam, and we understand that two of the engines are actually under construction, namely, at the plants of the New York Shipbuilding Corporation and the Newport News Shipbuilding & Dry Dock Company, respectively. The third engine has been designed by the Pacific Coast licenses of Werkspoor, namely, the Skandia Pacific Oil Engine Company, of Oakland, California; but we are not aware of actual constructional work having yet commenced up to the time of closing for press, although a number of 1,100 i.h.p. sets have been completed.

In Holland, the Werkspoor Company's first completed engine of this new size has just successfully run sea trials near Rotterdam in a new motorship of the Otto Thorensen Line of Christiana, Norway, although the engine was not run in the Amsterdam factory prior to being installed in the ship. In view of the differences in the construction of these four Diesel-engines, and because of their direct relation to future American shipbuilding, comparisons between the same of not a little importance at this time, as well as of general interest. Although these engines differ in a number of individual constructional features, all conform to the principal characteristics of Werkspoor design and experience, but each of the respective American companies has modified the engine in accordance with their own conception of the requirements of the American Merchant Marine and American shop practices. So far as we are aware the various British, Swedish and French licensees have not departed in any way from standard Werkspoor practice.

In no previous period of the development of the marine Diesel-engine has a similar situation arisen and the position of the American concerns in the shipbuilding world makes the matter one over which considerable technical discussion will arise sooner or later, particularly when more details of the three American engines are available. Their general specifications are as follows:

	Amsterdam Werkspoor	New York Werkspoor	Newport News Werkspoor	Skandia Werkspoor
Indicated horsepower	2,140	2,000	2,000	2,000
Brake horsepower	1,540	1,500	1,450	1,500
No. of cylinders	6	6	6	6
Cylinder diameter	26.378"	27"	27"	27½"
Piston stroke	47.244"	47"	48"	47¼"
Revs. per minute	110	110	110	100
Piston-Speed (per Min)	866'	862'	880'	787'
Brake h.p. per cyl. d	257	250	242	250
Ind. h. p. per cyl. d	357	333	325	333
Weight (short-tons)	235 tons	270 tons	240 tons	235 tons
Weight per i h.p.	220 lbs	270 lbs	240 lbs	235 lbs
Weight per b.h.p.	305 lbs	360 lbs	330 lbs	313 lbs
Mean effective pressure (per sq. in.)	72 lbs.	72 lbs.	63.3 lbs	92 lbs.*
Length over all (without thrusts)	33'11½"	34' 0"	35' 8"	40' 10"

*m. i. p.

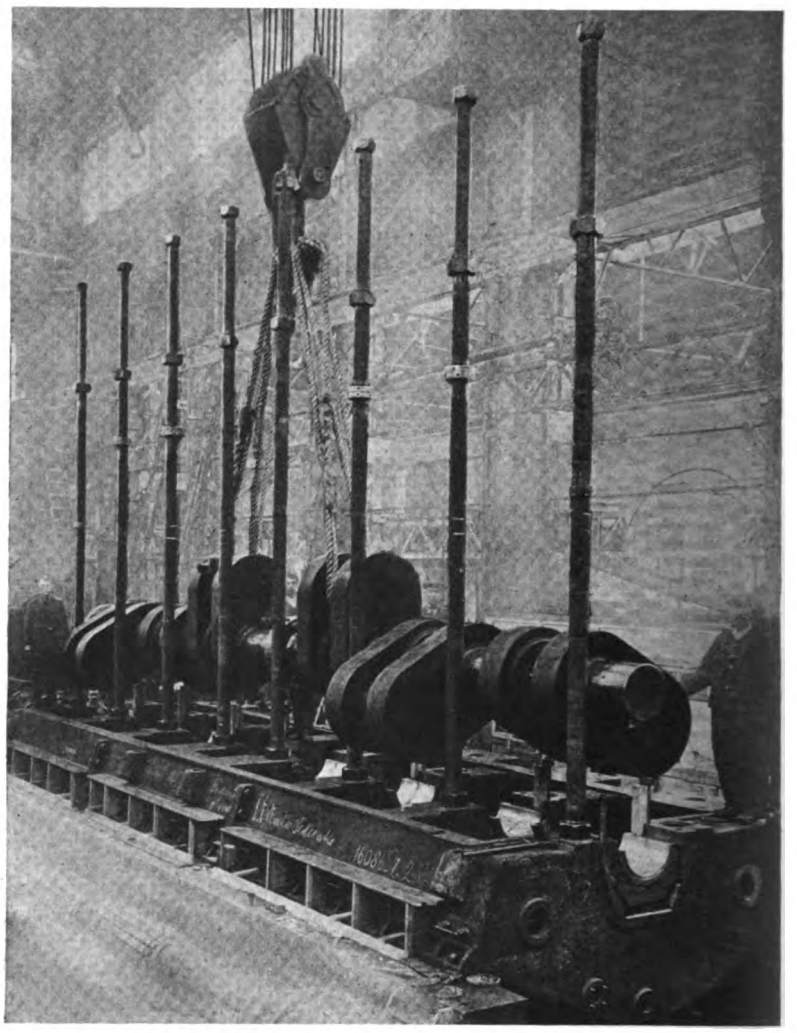
In the table we have quoted the maximum power of the Amsterdam Werkspoor engine, but the builders conservatively rate it as developing 1,940 to 2,140 indicated horsepower (1,400 to 1,540 b.h.p.) at 106 to 110 revolutions per minute with 72 per cent mechanical efficiency, and with a mean indicated-pressure of 89 to 98 lbs., according to respective power output. A fuel-consumption of 0.33 lb. per indicated horsepower hour is guaranteed, but in actual service with smaller sizes has proved to be well under this figure. In service the power is equivalent to 1,800 steam i.h.p. In the case of the engine the "Sardinia," it is intended to run regularly at 106 r.p.m. with a mean indicated-pressure of about 94 lbs. per sq. inch (6·5 Kg) and developing about 1,400 shaft h.p., which the builders regard as a safe average for long distance voyages.

It is not generally known that apart from twin-screw vessels about half-a-dozen single-screw Werkspoor Diesel-engined motorships have been in regular service since prior to the war, because some of them are consistently operating in the Dutch East Indies and have never left those waters since taken over by the owners, but the highest-powered of these boats, "Juno" and "Loudon," have only 1,400 i.h.p. on the single shaft, also in six cylinders. All Werkspoor engines are of course of the single-acting four-cycle type and are directly reversible by compressed air.

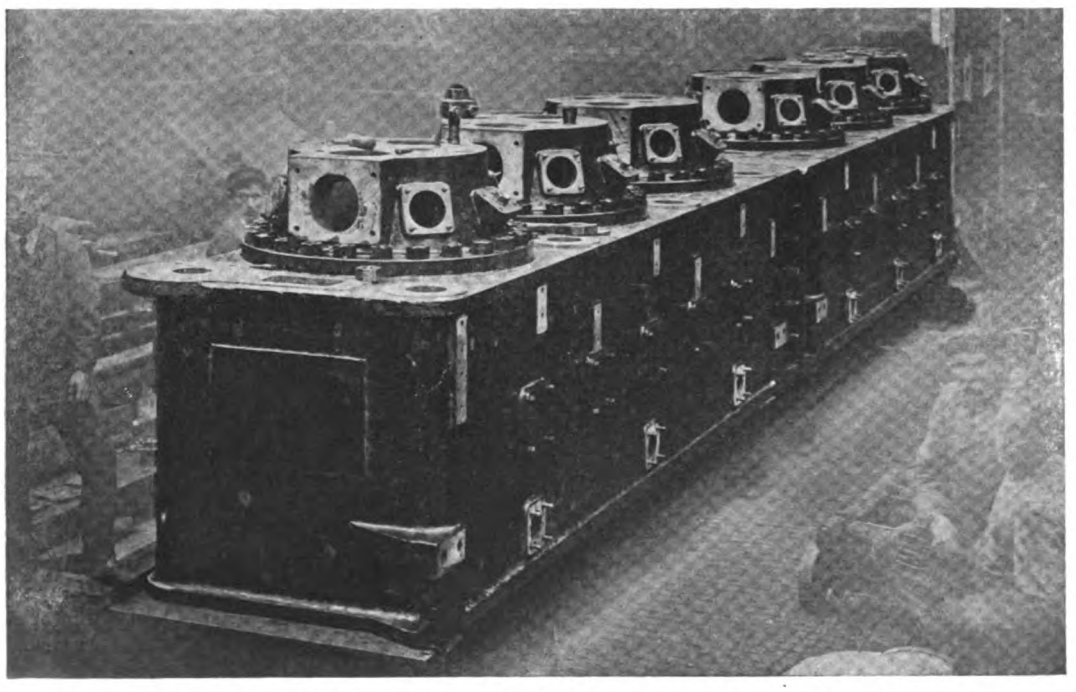
To return to the "Sardinia," she is not a large vessel, but has a fair turn of speed for a vessel of this size, being designed for 11 knots loaded, but unfortunately a heavy fog prevented actual speed being registered on the trial run. The vessel has the following dimensions:

Deadweight capacity	3,000 metric tons
Gross tonnage	2,644 tons
Net tonnage	2,014 tons
Length (B.P.)	303' 6"
Breadth (M.D.)	42' 2"
Depth (to main deck)	20' 4"
Draught (Loaded)	19' 3"
Speed (loaded)	11 knots
Power	1,940 to 2,140 I.H.P.
Average daily fuel consumption	6½ tons

She was built by J. & K. Smit & Co. of Kinderdijk & Krimpen a/d Lek, near Rotterdam, and was engined by Werkspoor of Amsterdam. She was constructed on metric lines and to metric dimensions, which her builders consider to be the most economical and scientific method. This claim suggests that American shipbuilders should study the metric-system as applied to domestic ship-construction, with a view to ascertaining if production costs could be reduced. The Skandia-Werkspoor engines are built to the metric system.



View showing bed-plate and one set of steel columns, also built-up crankshaft



Cylinder-box of the 2140 i.h.p. Werkspoor-Diesel engine showing cylinders in position. The steel columns run through these boxes down to the bed-plate

Our Netherlands editorial-representative, who was present at the trials of the "Sardinia," remarked that as her big Diesel-engine had not been given any shop tests, it would be remarkable if it ran for the ship's trial without trouble of some sort. However, everything worked even more smoothly than would have been expected if the engine had had extensive tests prior to being installed in the hull, regardless of it being the first of its power and in spite of the fact that difficulties of design grow with each increase in the cylinder dimensions. Also because 26 1/3-in. diameter is no mean size, although already exceeded by other makers. An engine developing 3,000 i.h.p. in six cylinders, or 500 i.h.p. per cylinder, is now being produced by Werkspoor, as previously announced in "Motorship," but we doubt if it will be ready this year. Also a Skandia-Werkspoor engine of 2,500 i.h.p. has been designed.

While designed to carry general cargo, the "Sardinia" also has accommodations for eight

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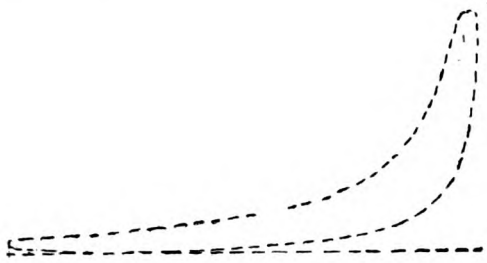


Card taken on trials at 106 R.P.M. The mean effective-pressure is 91 lbs.

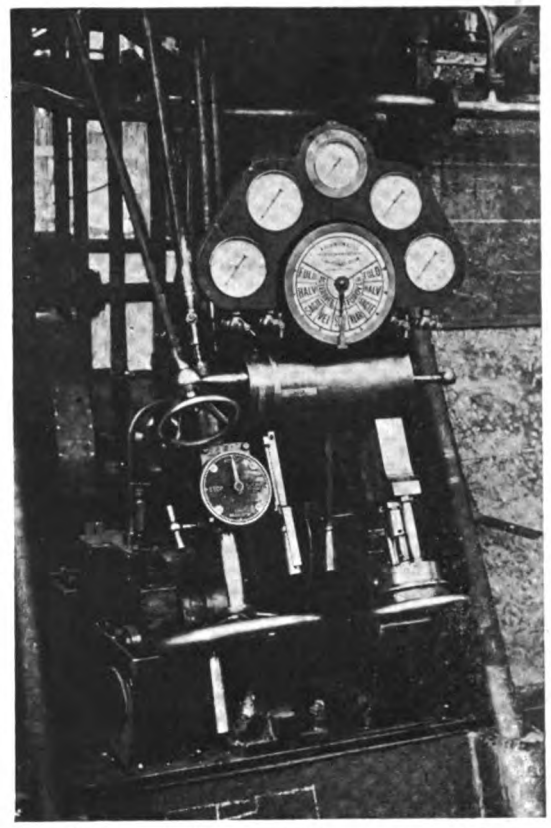
passengers, four roomy cabins, a saloon panelled in polished mahogany, bathroom, etc.; all the accommodations, including offices, are steam-heated by the Low system. With a total daily-fuel consumption of under 7 tons at 11 knots average loaded-speed, she obviously will be a very economical ship to operate, especially as only a small engine-room crew will be required. Also she will have unusual earning-capacity for her dimensions and power, because 300 tons of fuel will carry her over 10,000 nautical-miles, enabling her to carry about 2,650 tons of net, or actual, cargo on a voyage of that length in addition to the necessary fresh-water and stores.

We doubt if a steamship of her overall dimensions and power could be operated with profit in the ocean trades, under to-day's conditions, because her fuel-consumption would be excessive and because she would be unable to carry more than about 2,000 tons of net-cargo. But, obviously, the "Sardinia" can be operated with an excellent showing, for the reasons given.

As in the case of the trials of the motorship, "San Paulo" during February last, a dense fog prevailed on March 26th, when the trials of the "Sardinia" were run, and up to noon it looked as if they would have to be postponed. But the fog lifted a little, and at 12:27 P.M. the order "Slow Ahead" was rung down to the engine-room and, 4½ seconds later to be exact, the engine was turning its first revolutions under power, propelling the ship. Soon the speed was increased to 90 r.p.m., and at 1:35 p.m. she overtook the steamer "Eastminister Abbey." At 2 p.m. the engine-speed was brought up to 95 r.p.m., and an hour later was turning at 106 r.p.m., developing the full normal-load.

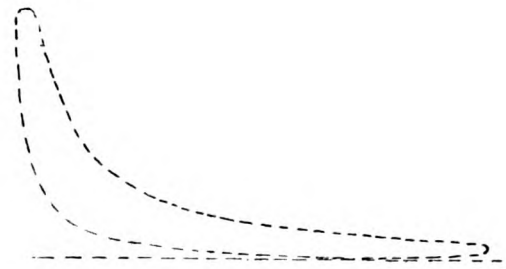
After the vessel had been an hour in the open sea, the fog descended again, and was so dense that the pilot decided to turn back and "creep" into the mouth of the New Waterway as quickly as it could be found. From then until 7 P. M. the vessel was run up-and-down the river at full speed. It is to be recorded that from the time the engine was started, a period of 7½ hours, they ran smoothly and without a suggestion of trouble, performing every manoeuvring order from the bridge within five to ten seconds. For starting, stopping and speed variation five seconds were taken, and ten seconds from full-ahead to full-astern, or vice-versa. The exhaust-gases were perfectly clear, no noise emanated from the engine-room, and the vibration of the ship was hardly noticeable, although she was in a light condition. In fact, in the saloon it was difficult to tell whether the main engine was running or not. The slight trembling perceptible came from the three auxiliary Diesel-electric generating-sets that were kept running throughout the trip for trial purposes. All cylinders gave excellent indicator-diagrams of which two examples accompany this article.

It is possible that the situation of the main engine on the centre line of the ship and a well-balanced propeller may partly account for the absence of vibration, but no doubt the excellent balancing of the working parts of the main engine are largely responsible. Because of the short run, no fuel and lubricating-oil consumptions were taken with a degree of accuracy, but these will be available after the maiden voyage. Also the builders did not desire to crowd the engine-room with more or less useful "experts" merely taking readings, but otherwise obstructing the movements of the regular engine-room crew, owing to the fog. As the trials were not held in the open sea, but in the New Waterway, it was not possible to use the log, and the tide in the estuary caused elements of uncertainty. But, in view of the ease with which she overtook the "Eastminster Abbey," no fears regarding not obtaining her designed speed need be entertained.



New control-gear of Werkspoor engine

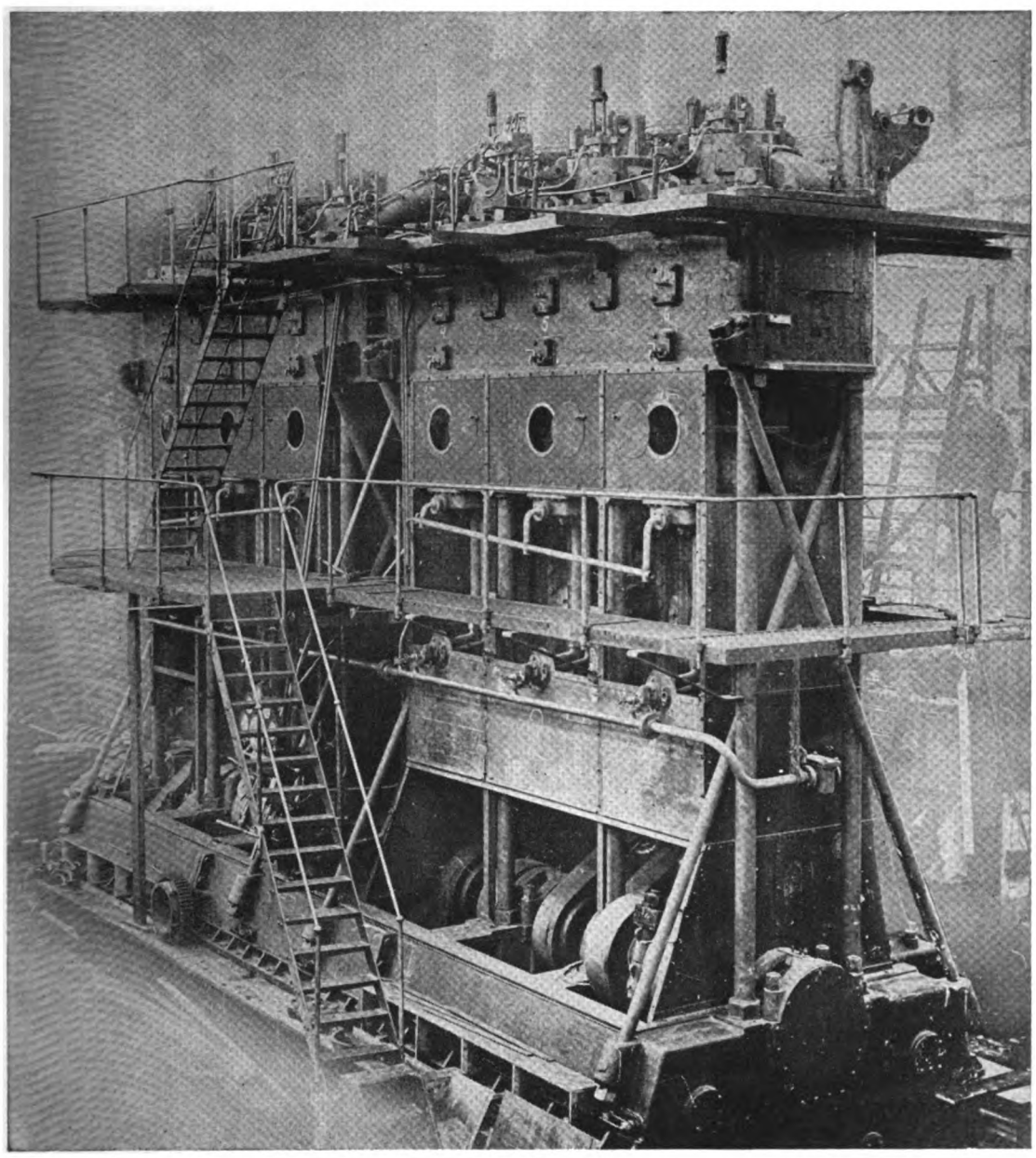
The main engine follows the general design of the 1,400 i.h.p. Werkspoor Diesel engine with its combination of steel and cast-iron, diagonal stays, columns and cylinder-box construction, already described in these pages, so need no lengthy description. The crankshaft is of Siemens Martin steel of the built-up type 415 mm. diameter, and with main-bearings 530 m.m. long. The crank-pin is 3770 m.m. long, and the piston-rod 110 m.m. diameter



Indicator card from Werkspoor 2140 i.h.p. engine at 106 revs. per min. taken on ship trials. M.E.P. 89 lbs. per sq. in. Temperature of exhaust, 707 deg. Fahr.

Recent improvements developed with this design, including the new reversing system, the improved air-intake which is very silent, and the adjustable crankshaft bearings, also the simplified system of manoeuvring levers, have been incorporated. Possibly, however, the form of manoeuvring levers may be changed with later engines because rounding-off the ends and arranging for the largest diameter at about three-quarters from the end may give a more ideal grip. This, of course, is a matter of minor importance, but sometimes such apparent trifles are overlooked by engineers who have far greater problems to solve.

As regards auxiliaries in the engine-room, one of the most important units is a two-crank three-stage air-compressor driven by an electric-motor of 150 b.h.p. at 275 r.p.m., the motor having been



The 2150 i.h.p. Werkspoor four-cycle Diesel engine of the new single-screw motorship "Sardinia"

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made by the Electrotechnische Industrie voorheen Willem Smit of Slikkerveer, Holland, and the compressor was built by Werkspoor. This is installed at the forward end on the port-side. Next there is a three-crank pump, also electrically-driven. One pump serves as an emergency air-compressor, one for bilge and deck-service and, the third for emergency cooling-water circulation. Then there is a small steam-driven air-compressor, also for emergencies, and it is supplied with steam from a small Werkspoor-built Scotch-type donkey-boiler. It hardly is necessary, as there is a little compressor driven by a 6 b.h.p. Kromhout surface-ignition oil-engine at 550 r.p.m., so we presume it is fitted to comply with Lloyds regulations. This oil-engine also drives a small electric generator.

On the starboard side of the engine-room there are two centrifugal pumps each connected to a 24 b.h.p. electric-motor turning at 1,450 r.p.m. These serve for bilge, ballast and cooling-water purposes, and are at the after end. Nearby it is the switchboard. There is a 11 h.p. 6½ K.W. 220-volt motor-driven dynamo for lighting purposes. The short oscillations to be found in the current from the Diesel-driven generators are compensated by it and a steady current results. Possibly if fitted with a flywheel of about a thousand pounds running on ball-bearings, such an arrangement could be made to form an excellent emergency generator. And, if by any chance the main current became cut-out, this set would continue to produce current for lighting for several minutes, allowing time to change a fuse or start another engine.

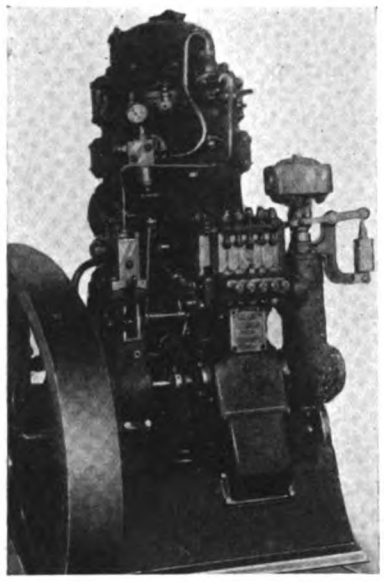
It is very unfortunate that we are unable to give any engine-room plans of this ship because the arrangement of auxiliary Diesel-engines is quite novel. It differs from the usual plan in that they are installed diagonally on the port side of the engine-room, and so allow ample space for the engineers to walk around. It will be realized in a ship of but 42 ft. breadth, and such high power, there is none too much room in the machinery compartment.

These auxiliary Diesel-engines are the Werkspoor standard four-cycle type, and each develops 100 b.h.p. at 250 r.p.m. from two single-acting cylinders 320 mm. bore by 450 mm. stroke. Each is direct coupled to a 65 K.W. "Electro" generator, the latter being the trade-name of the Willems Smit Company already referred to.

VEGETABLE-OILS AS FUEL FOR SURFACE-IGNITION OIL-ENGINES

Interesting experiments with vegetable-oils as fuel for surface-ignition oil-engines have been carried out at the worke of Ansaldo-San Georgio Ltd., Turin, Italy. The engine used was a standard single-cylinder model of 20 b.h.p. at 400 r.p.m., taken from stock. With this design the admission of scavenging-air to the cylinder is controlled, and there is no injection of fresh water, the latter feature now having been abandoned by most makers, and the cylinder-head is water cooled instead.

With the Ansaldo-San-Giorgio design, the cooling of the cylinder-head consists of a large oblique canal, connecting the cylinder cooling-chamber to the hot-bulb on the head, and prevents the bulb attaining too high a temperature, thus dispensing



Ansaldo-San Giorgio 20 b.h.p. surface-ignition oil-engine that ran tests on vegetable-oils

with water injection. By means of the device to control admission of scavenging-air, the vulpmetric efficiency of air drawn in can be maintained as high as possible, but proportioned always to the quantity required for scavenging. Better combustion results and a higher efficiency of power, with suppression of the resistance offered to the air by the ordinary automatic valves. This device is shown by rotary cylindrical valve B, in Figure 1.

The first series of experiments was made, employing ordinary heavy-oil with a specific gravity of 0.9. The results were as follows:

Rev per min.	B. H. P.	Consumption per B. H. P. Hour
405	23.5	260 gross
411	27.3	293 gross

Being a high-speed engine, and as the power developed is overload, the consumption is noteworthy low.

The second series of experiments was made with Winter Cotton-Oil, having following characteristics:

Colour = yellow (straw).
Limpidity = opalescent.
Density at 15° = 0,092.
Inflammability temperature = 185° C.
Ignition temperature = above 250° C.
Reaction = neutral.
Calorific power = 9573.

As it may be seen, the values of viscosity and density, and the points of inflammability and ignition are all high—in comparison to the heavy-oils usually employed; therefore the use of above oil as fuel should not seem to be possible with all types of engines. The experiments gave the following results:

Revs. per min.	B. H. P.	Consumption per H. P. Hour
412	22.8	299.1 gross
413	25.7	340.9 gross

While with heavy-oil the discharge of the burnt gases was absolutely invisible, it presented with cotton-oil slight smoky traces.

The third series of experiments was made with palm-oil having the following characteristics:

Colour = yellow.
Consistency = buttery.
Density at 15° = 0.9
Engler viscosity at 50° = 3.5.
Inflammability temperature = 280° C.
Ignition temperature = 325° C.
Calorific power = 9350.

Following have been the results of this third series of experiments:

Revs. per min.	B. H. P.	Consumption per B. H. P. Hour
423	21.1	312 gross
395	24	328 gross

The consumptions, compared with those of heavy-oil, are higher, but the ratio is nearly equal to that of the calorific powers. Also here the discharge of burnt gases was almost invisible. After the experiments, the bulb was removed, and only very slight traces of carbonious deposits were found.

The above experiments have a very important interest, owing to their essentially practical nature, which leads to further experimenting of use of hot-bulb engines. This is important because a wider field is opening to their employ in the extended colonial territories, as well as in all those countries where vegetable-oils abound, and where natural conditions of ground, difficulties and poor transport facilities, distance from oil-wells, make the supply of mineral-oil scarce and expensive.

PERFORMANCES OF ITALIAN MOTORSHIPS

The "Ansaldo San Giorgio" motorships of Società Nazionale di Navigazione, of Genoa, are continuing very successfully their operating in trade between Italy and Valparaiso through Panama Canal. Over 60,000 nautical miles have been covered by each of these motorships with complete regularity, so that their engines have demonstrated to be thoroughly reliable and economical, two-cycle Diesel engines. Following are two statements referring to a voyage of motorship "Ansaldo San Giorgio II" from Genoa to Valparaiso and return.

Consumption Schedule

	Propelling—engines				Donkey-boiler	
Consumption	Hours run	Density	Fuel	Lub. oil	Hours	Fuel
Harbor....	.....	.....	.....	.....	1,209	132.4
At sea.....	894.4	0.9	360	16.912	132	15.6
Total..	894.4	0.9	360	16.912	1,341	148.0

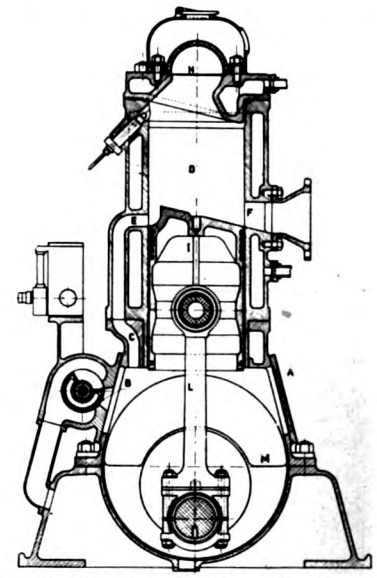
Mean Consumptions

Consumption per shaft H.P. hour. Fuel: 191 grams. Lubricant: 4 grams.

These figures relate to the voyage during which the following harbors were touched:

	Arrival	Departure
Genoa		5th of April
Marseilles	6th of April	6th
Barcelona	7th	9th
Cadiz	12th	13th
Teneriffe	16th	17th
Trinidad	27th	28th
La Guaira	29th	1st of May
Porto Cabello	2d of May	2d
Curacao	3d	3d
Sabanilla	5th	9th
Cartagena	10th	11th
Colon	13th	13th
Panama	13th	15th
Bonaventura	16th	21st
Puma	23d	24th
Guayaqui	26th	25th
Callao	28th	1st of June
Mollendo	3d of June	3d
Arica	4th	4th
Antofagasta	6th	6th
Valparaiso	9th	14th

From above dates it will be easily seen that the engines were stopped only for very short times, the ship anchoring in open bays, not in harbor,



Section of the Ansaldo-San Giorgio surface-ignition oil-engine

always ready to start at a moment's notice. The voyage was accomplished without any delay. The consumption schedule of the return voyage was as follows:

Consumption Schedule

	Propelling—engines				Donkey-boiler	
Consumption	Hours run	Density	Fuel	Lub. oil	Hours	Fuel
Harbor.....	.....	.....	.....	.....	686	68.4
At sea.....	1,008	0.9	415.9	17.614	.....	.....
Total..	1,008	0.9	415.9	17.614	686	68.4

Mean Consumptions

Consumption p. HP. hour Fuel: 195 grams; Lubricant, 4 grams

These figures, referring to a complete voyage chosen among the usual voyages of the above-mentioned motorship, are a clear testimony of reliability.

The aforesaid reliability is demonstrated by the fact that the "Società Nazionale di Navigazione" have decided to operate two of these motor-freighters on new routes. On the 15th of April inst. the "Ansaldo San Giorgio I" and the "Ansaldo San Giorgio III" will start from Genoa: the first for a voyage for the eastern ports of South America, viz., Rio de Janeiro, Santos, Buenos Aires, etc.; while the "Ansaldo San Giorgio III" will touch the Asiatic ports: Port Said, Bombay, Colombo, Calcutta, Singapore, etc., etc.

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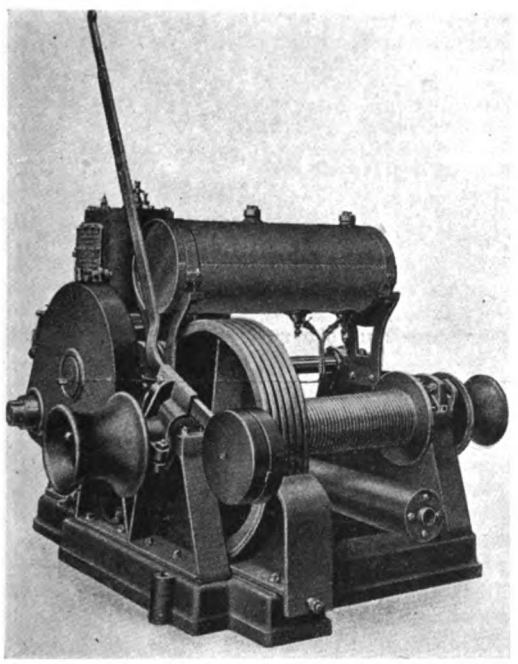
A Simple Motor-Winch

On both coasts of this country a large number of sailing-vessels, both cargo-carriers and fishing-boats, have no mechanical propelling-power. To such a craft a power-winch is a boon and an economy, because of the big saving of time and labor. In such installations the power has to be furnished directly with the winch, and it is usual to have the same provided by a gasoline-motor operating direct.

We have before us details of a motor-winch of this type built in England by a well-known company specializing in gasoline and kerosene engines, namely, Smart & Brown, of Erith, Kent, and reference to the illustration will show that it is of a very practical design. It was nearly 10 years ago we first saw one of these winches, and now note that except for minor modifications and improvements the design and construction is still virtually the same as it was then, as it has been thoroughly standardized. By means of the particular arrangement adopted the slipping-clutch problem, for long the great stumbling block in motor-winches, has been overcome successfully.

The equipment is mounted on a cast-iron bedplate, which is hollow, and contains the cylinder cooling-water, thus being entirely self-contained. The winch itself is merely a drum driven off the engine by a large friction-pulley entirely controlled by one lever, which throws the friction-drive in or out of action as required. The friction-drum has four grooves on the driving pulley. It is driven by a Smart & Brown single-cylinder gasoline or kerosene motor of the four-cycle type having a 4-in. bore and stroke and 4 h.p. is developed at 950 r.p.m. High-tension Bosch magneto-ignition is fitted, the magneto being chain-driven off the camshaft. Over the engine is a double tank of three gallons capacity, allowing for two gallons of kerosene and one of gasoline, so that the engine can be run on either fuel. This



Smart & Brown cargo motor-winch designed to meet British Admiralty requirements. Will lift 1½ tons at 88 ft. P.M.

allows for about nine hours running without replenishing. Although it would hardly be possible to construct a more simple winch, it is quite capable of dealing with the work required, and can lift 5 cwt. at 140 ft. p.m.

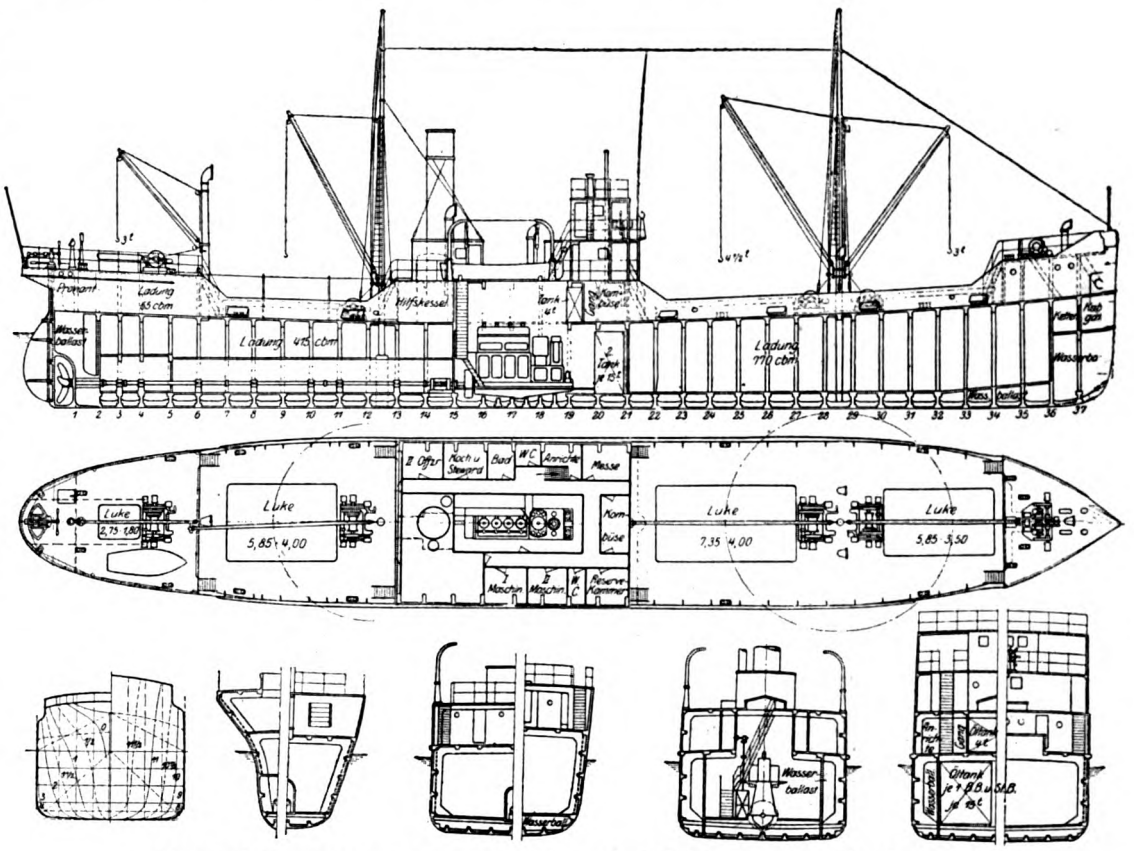
Besides doing the work quicker when in use on barges, sailing-ships, etc., a chain-wheel can be had for raising the anchor, also a pulley can be applied for pumping the bilge-water or even to drive a propeller in a calm. In cases where small vessels have oil-engine propelling power, and oil-engine-electric auxiliary power, we presume that this winch could be fitted with an electric-motor, instead of the oil-engine.

GERMAN CONCRETE MOTORSHIP "GOTAALF"

Practically every maritime country turned to the construction of concrete motorships during the latter stage of the war. On this page we give drawings of the German concrete 800-tons motorship "Götaälf," built for the Baltische Reederi (August Bolten), of Hamburg, by the Reederi Motorfrachtschiff eus Eisenbeton. This vessel is propelled by a four-cycle two-cycle type Sulzer-Diesel engine of 410 shaft h.p. and the auxiliary air-compressor is driven by a 12 b.h.p. oil-engine. She has the following dimensions:

Length	184 ft. 8 in.
Breadth	27 ft. 4 in.
Depth	14 ft. 4 in.
Deadweight capacity	800 tons
Power	410 i.h.p.
Speed	9 to 9½ knots

The Götaälf was launched on October 27 last, and interesting illustrations showing her under construction appeared in a recent issue of "Werft & Reederi." The Sulzer engine was built at Wilhelmshaven.



Plans of German concrete motorship with 410 b.h.p. Sulzer-Diesel engine

Operation of American Motorship "James Timpson"

ONE of the functions of this publication is to follow the progress of old motorships in order to satisfy our readers and ourselves of their reliability and efficiency under regular sea-going conditions. Particularly interesting are the performances of American wooden motorships built under war-time conditions, especially because of the absolute failure of the wooden steamer fleet as post-war carriers and their doubtful value as emergency vessels. Many of our readers will remember the 1,700 tons d.w.c. wooden motorship "James Timpson," built early in 1918 by the G. M. Standifer Construction Company of Portland, Oregon, for the Resolved Corporation of New York City (Ichabod T. Williams & Co.) from designs by Cox & Stevens, and powered by twin Winton 450 shaft h.p. Diesel-engines.

Under recent date her owners wrote us regarding the operation of the "James Timpson" as follows:

"At present we are operating her motors at 220 revolutions per minute, with the result that the vessel attains a speed of 7½ knots. Formerly we ran the engines at a somewhat higher rate, but find that fewer repairs are necessary when they are run at a moderate speed.

"We feel that one of the great needs of the American merchant-marine is the proper training of a large number of motor-engineers and mechanics, which would greatly facilitate the making of proper and speedy repairs on our American motorships, and also would insure their efficient operation at all times.

"In the case of the 'James Timpson' we have succeeded in building up an organization in our engine-room which is admirably efficient, especially as we are now securing splendid co-operation from the deck department. The reason for our success in this matter is very largely due to the efforts of Captain R. E. Hocken and Mr. H. Christensen, Chief-Engineer of the vessel.

"American shipyards also have been gradually improving in the quality of the mechanical personnel available for Diesel repair work, and no doubt if further efforts are made it will be possible in the future to find proper repair conditions in all parts of the United States.

"One warning should be sounded, however, in regard to the conditions which prevails in the bunkering of motorships at American ports. Certain oil advertised for Diesel purposes is not well adapted for motor use, and unless a careful test is made of all oil on board ship before using it in the engines, considerable trouble is likely to eventuate. We believe that Diesel fuel-oil should have a paraffin basis, and there should not be more than a trace of the sulphur content.

"An almost incredible efficiency has been obtaining on the 'James Timpson' as regards the daily consumption of fuel-oil. While making a speed of seven knots, the vessel has an average consumption of 14 barrels of high-grade fuel-oil daily, which is at least 50 per cent better than the manufacturers guaranteed. We have not seen any record of any motorship afloat which equals in this respect that of the 'James Timpson.'

"During the last few months the vessel has been running steadily in the mahogany trade without any stoppage or delays due to engine trouble, and we append her record in this respect as follows, commencing with the vessel ready at New Orleans January 26, 1921:

		Days
Voyage 9—	New Orleans to Belize (in ballast)	5
	Loading mahogany at Belize	7
	Belize to New Orleans (with cargo)	5
	Discharging mahogany at New Orleans	5
Voyage 10—	New Orleans to Belize (in ballast)	5
	Loading mahogany at Belize	7
	Belize to New York	10
	At New York, discharging, fumigating and bunkering	8
Voyage 11—	New York to Bluefields (in ballast)	13
	At Bluefields for orders	2
	Bluefields to Belize	3
	Loading mahogany at Belize	7
	Belize to New Orleans (with cargo)	5
		82

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Electricity Applied to Ship Auxiliaries

Extract from Paper Presented at the Joint Meeting of the N. Y. Section of the American Institute of Electrical Engineers and the Metropolitan Section of the American Society of Mechanical Engineers, New York

By H. L. HIBBARD

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(*Continued from page* 309, *April issue*)

For merchant vessel work open or ventilated motors are usually employed. If for the direct connected electrical type they would be compound wound and for th hydraulic system shunt. wound. For the control of the direct electric type, contactor panel would be supplied in the steering gear room with steering stations at such points as desired, with a selective switch on the control panel to delegate the control to any one of these. For the hydraulic system the control equipment resolves itself usually to simply a starting panel for the main motor and in merchant work the control of the valve with the hydraulic gear has frequently been by means of a hydraulic telemotor or tiller rope transmission. Electric-pilot motor-control, however, can and has been supplied either of the follow-up or non-follow-up type.

For ships operated by Diesel engines or Diesel-electric drive, it is obviously of great advantage to operate all the engine-room auxiliaries by electricity, as it is largely a question of the efficiency of electric transmission with a large and reliable generating unit, against a number of small inefficient oil or steam engines,

Aside from the engine-room auxiliaries referred to above, attention is particularly drawn to the deck auxiliaries which are located some distance from the generating plant and where great losses would take place in the steam pipes feeding them. In these cases the electric drive is by far the most efficient method, irrespective of whether the vessel is steam or oil engine propelled. It has always been noted by the writer that there is an almost complete absence of reliable figures on steam consumptions of steam driven auxiliaries and inquiries usually bring out simply the information that an 8 by 10 engine for instance, etc., is used, without any data as to its actual efficiency or steam consumption. Some idea can be obtained of the loss of steam on the steam type of auxiliary when it is remembered that it is frequently considered essential to keep steam on the winch and windlass engines in cold weather to prevent the cylinders cracking or pipes bursting from freezing. The steam steering-engine is a particularly noteworthy example of the wasteful use of steam as it is in effect only a steam ram taking steam full-stroke with valves always left "cracked" a small amount.

The electric motor is always operating at a point of high efficiency and does not suffer in this respect from change of climatic conditions. Furthermore, the power transmitted through electric cables is practically a constant quantity regardless of temperature conditions, while steam transmission is affected very decidedly thereby. Electric drive in addition to its convenience, adaptability and ease of operation, has the further merits of being available at any instant without preliminary warming up, or as above stated, the losses while standing idle with the steam plant.

Space, Weight and First Cost. Comparative figures which have been reliably obtained indicate generally some increase in the weight and space occupied for the electric over steam drive. In some cases however, such as the steering gear, an actual saving in space and weight is usually effected with the electric, and in other cases the difference is very slight. In the matter of first cost, it is also apparent from such figures as have been available to date, that electrical auxiliary machinery is roughly about 20 per cent. more expensive than steam, except in case of deck winches where the difference is more, sometimes 100 per cent.

These figures of first cost, however, we feel are influenced to a considerable extent at the present time by the lack of a developed line of apparatus on the part of many manufacturers and that in many instances full development costs have been charged against the first installations of electric auxiliaries which would be absorbed in later installations.

As against these disadvantages of first cost and weight, are obtained the advantages of:

1. Suppression of heat in spaces adjacent to the gear and transmitting lines which is of importance in certain cases.

2. Elimination of accidents due to freezing and bursting of steam pipes, cylinders, etc.

3. The reduction of vibration and noise and an increase in the habitability of the ships due to these factors. This is particularly marked in the case of the steering gear.

4. The simplification and flexibility of control, operation being obtained readily from the most convenient point.

5. The obtaining of mechanisms as outlined above which are very much more efficient in operation than the steam equipments. This is the most important consideration.

Economy of Operation. That without question a very appreciable saving in the fuel consumption can be obtained by the use of electric drive.

Another important consideration is the fact that experience shows on motorships already constructed with electrical auxiliaries, that in port the power required during the period that the deck winches are handling the cargo is about three times the amount required with the auxiliaries at sea. Investigation of cargo handling vessels in general has shown furthermore that winches are idle five to eight times the amount of time they are in operation during an eight hour day of work. With electric drive power is completely shut off while the winches are out of operation, but in the case of the steam equipments condensation and leakage continues the same.

While we have numerous general advices to the effect that the fuel consumption of steam driven auxiliaries is at least ten times that of electric, etc., we have some specific figures from oil-engine driven vessels of the *Benowa* and class which are in operation on the Chilberg line and plying between Australian points and the Pacific Coast. The following figures are given for two vessels, the *Benova* equipped with electrical auxiliaries, and the *Cethana*, equipped with steam auxiliaries, as follows:

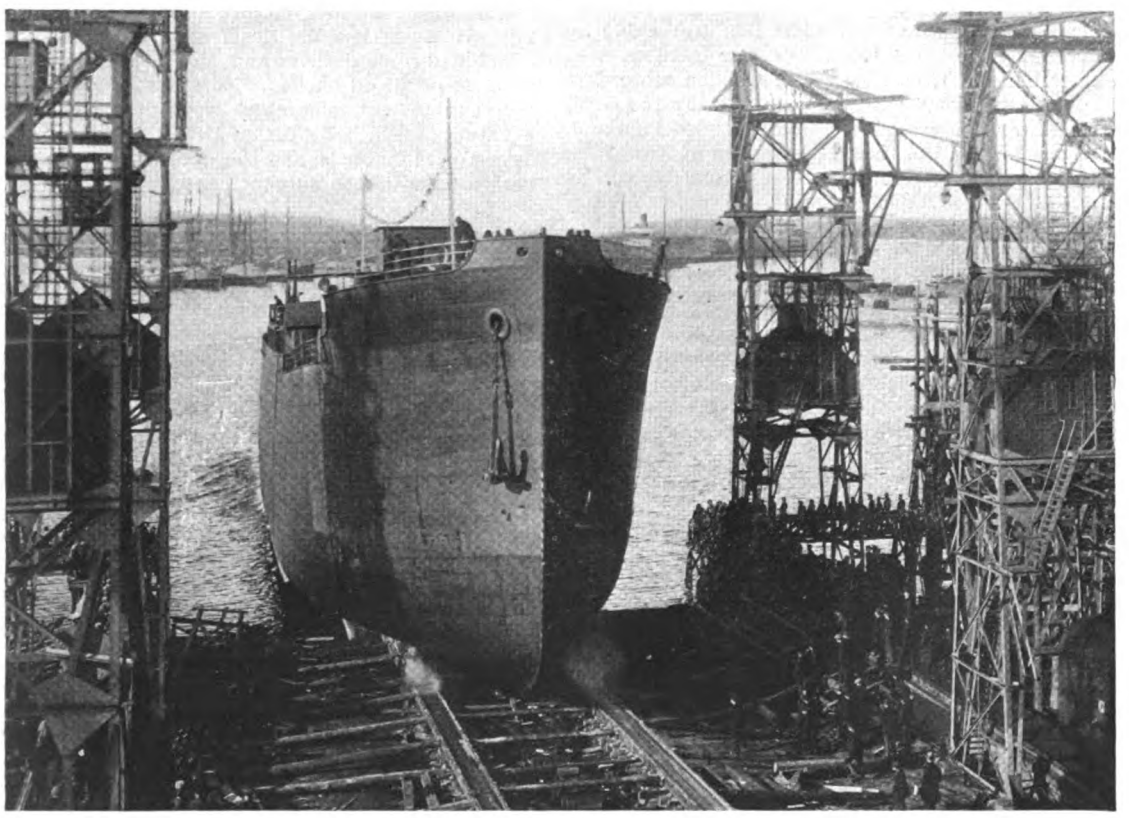
	Benowa	*Cethana*
Net registered tonnage	1788	1800
Propulsion	2–500 h.p. Diesel Engs.	2–500 h.p. Diesel Engs.
Average daily fuel-consumption-main engines.	1350 gal.	1365 gal.
Average daily fuel-consumption-donkey-boiler.	Nil	557 gal.
Average daily fuel-consumption-auxiliary Diesel Engines	42.5 gal.	Nil
Total daily fuel-consumption	1392.5 gal.	1922 gal.
Per cent of total fuel used for auxiliaries	3.4%	29%

The above shows a saving of approximately 25 per cent. in fuel consumption due to Diesel-electric auxiliaries. Examination of the records of other ships shows a similar percentage gain.

[Mr. Hibbard's percentages are a little misleading, as in figuring the economy as 25% he has included the "at sea" consumption of the main engines in each. When in port the "Benowa" consumes 42½ gallons and the "Cethana" 557 gallons per day, or a saving of over 1,000% in favor of Diesel-electric auxiliaries. His error was due to taking the total fuel-consumptions instead of only the port-consumptions.—*Editor.*]

In handling miscellaneous general cargo during this period also, approximately 20 per cent. more cargo was estimated as handled with electric-winches than with steam.

We have incidentally, furthermore, advices that for two sister ships recently constructed and operating in the Pacific, one equipped electrically and the other with steam auxiliaries, for a period of six months the repair bill on boilers and steam winches was $3800, while repairs to the generating sets and electric equipment for the same period was only $92.00. We appreciate the fact of course that this was undoubtedly an unusual condition, some accident probably happening to the steam plant, but we emphasize the point that repairs are necessary to steam equipments and that if some repairs are occasionally necessary for the electric, it should not be considered a matter of discredit to the electric drive.



Launch at the Oresunds Varvet, Landskrona, Sweden, of 4,450 tons d.w. motorship for the Swedish Levant Line. She will run trials this month. A Götaverken B. & W. long-stroke Diesel-engine of 1,600 i.h.p. will be installed. (See page 44, January, 1921, and page 216, March, 1921.)

Electricity Applied to Ship Auxiliary

This direct method of drive is accompanied usually by a very inefficient mechanical transmission, the screw-gear for instance giving an efficiency usually of 30 to 40 per cent. As a means therefore, of providing more efficient transmission, the hydraulic speed gear is now frequently employed particularly for installations of large horse-power where the saving, owing to the more efficient transmission, is very marked.

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Further Performance of Motorship "California"

Has Completed 41 Voyages Aggregating 253,829 Nautical Miles at 9.71 Knots Average Speed Since Sept. 30, 1913, Carrying Full-Cargoes During Entire Period.

WHEN in January, 1919, we published the results of thirty-one voyages of the Danish motorship "California," we found that she had covered a total of 180,144 nautical-miles in 18,496 hours at an average speed of 9.73 knots. Forty-one voyages have now been rounded out, making a total of 253,829 nautical-miles at an average speed of 9.70 knots. That is running close to the old figure for a boat that began her voyaging September 30, 1913. She was operating at practically full load during most of this period. Variations in the speed occurred, sometimes on account of the inequalities of the fuel, and at other times because of accumulations on the bottom from sailing in torrid waters.

On March 23, 1921, the " California," which is owned by the United Steamship Co., of Copenhagen, completed a voyage from Buenos Aires to New York with a cargo of linseed, which was discharged promptly and economically by means of pumps. This ship, the New York agents for which are Funch Edye & Co., is a Diesel merchantman that has seen nearly eight years of service and is good for many more similar periods. Her recent trip of 12,516 nautical miles was made in 1,271 hours, at an average speed of 9.85 knots and on a daily fuel consumption of 9,500 kg.

Captain P. G. C. Pedersen of the "California" emphasizes the absolute necessity for a well-trained engineering staff. Twelve picked men constitute this department, with C. V. Hendriksen as chief-engineer. It would be difficult to convince the Captain that anyone but a Scandinavian would come under the class of best engineers. Without question, the Scandinavian Peninsula has produced sea-roving men for hundreds of years. Some of the fiercest pirates have come from that bleak country, as well as some of the best pilots and some of the most efficient engineers. Let us admit all that by all means. We can say also that no boat could be better manned and officered than the "California."

But we must not forget for one instant, however, that there is no country in the world better equipped for the study of engineering subjects than the United States of America. We have good schools, good teachers and good students. How, then, do we account for the position of our merchant marine? That is another story and a long one, too, but the day may not be far distant when American Diesel-driven ships will dot the ocean in vast numbers

If more Americans would engage in a seafaring life, conditions might improve more rapidly. Because life at sea is becoming more and more attractive, young men of this country would do well to consider it as a possible vocation. The old-time hardships of such a life have been gradually disappearing. Many changes for the better have taken place aboard ship during the last few years, and chief among the causes for such betterment may be mentioned the internal-combustion oil-engine.

What could be more attractive and interesting than the recent voyage of the "California" from Buenos Aires to New York? It was very different from the old-time coal-shoveling trips with their dust and dirt and fiery furnaces. Even the discharge of the cargo at the end of the recent voyage entailed no hardships. The linseed was simply drawn-up through large pipes, while Captain Pedersen and Chief-Engineer Henriksen lounged about and read the latest number of "Motorship." Such a picture is not much overdrawn, for sea life is passing through kaleidoscopic changes. The young engineer of ability should think twice before discarding thoughts of the sea as the scene of his labors. Such a life has an immediate future that is worth a serious consideration on the part of those inclined that way and fitted for such an occupation. In some forceful manner, the youth of America should have brought to their attention the many advantages of a life on the highsea, for the prospects are continually broadening. Shipowners should train young engineers to Diesel engine operation and include sea-experience as part of the educational course.

According to the figures secured by the writer while on board this interesting vessel, her dimensions differ slightly in several respects from those previously published in "Motorship," but are approximately the same:

Loaded Displacement	12,000 tons
Light Displacement	3,800 tons
Deadweight Capacity (on 10,000 mile voyage)	8,100 tons
Net Cargo-Cargo Capacity (on 10,000 mile voyage)	7,680 tons
Cubic Capacity (grain)	478,000 cu. ft.
Cubic Capacity (bales)	442,000 cu. ft.
Bunker Capacity	840 tons
Cruising Radius	20,000 miles
Fresh Water Capacity	45 tons
Gross Tonnage	4,611 tons
Power	2,400 I. H. P.
Length of Machinery Space	42 ft.
Length of Ship (O. A.)	425 ft.
Length of Ship (B. P.)	405 ft. 4 in.
Breadth (M. D.)	54 ft. 2 in.
Draught (Mean Loaded)	25 ft. 1 in.
Daily Fuel Consumption at Sea	8½ tons
Daily Fuel Consumption in Port	¾ ton
Consumption per I. H. P. hour	160 grams*

She was built and engined by Burmeister & Wain of Copenhagen, Denmark. Her engine-room crew consists of 12 men.

*453.6 grams equal 1 pound.

Performance of the Motorship "California," Nov., 1913 to March, 1921:

Voyage Number	Distance in Nautical Miles	Number of Hours	Average Speed in Knots
1	8,054	809	9.95
2	4,743	568	8.35
3	4,174	408	10.16
4	4,874	545	8.94
5	3,999	379	10.55
6	4,951	498½	9.99
7	4,444	421¼	10.64

The m.s. "California" at New York

8	4,605	498½	9.24
9	4,701	486¾	9.63
10	4,570	570	8.01
11	4,462	459¾	9.70
12	4,653	479	9.86
13	4,366	417¼	10.51
14	5,812	510¼	11.38
15	4,991	500	9.98
16	4,461	462	9.65
17	4,761	492	9.77
18	3,925	357¼	10.98
19	5,336	521¼	10.23
20	4,019	387¼	10.37
21	4,086	460½	8.87
22	4,202	461¾	9.10
23	4,020	433	9.28
24	4,237	498½	8.53
25	4,404	448¼	9.82
26	4,583	432¾	10.59
27	8,331	805¼	10.41
28	13,857	1,402½	9.88
29	12,295	1,291	9.52
30	11,989	1,207¾	9.92
31	12,266	1,285¼	9.54
32	5,057	631	9.60
33	5,929	570	10.40
34	13,919	1,459	9.54
35	7,006	655	10.69
36	7,074	822	8.60
37	4,242	412	10.29
38	3,927	395	9.94
39	4,453	445	10.00
40	8,562	962	8.89
41	12,516	1,271	9.85
Total	253,829	26,118	9.70

Surprise was expressed by the officers of the "California" at the lack of enthusiasm over Diesel propulsion for American ships. It is true that much progress has been made, but considering the fact that the United States is so plenteously supplied with oil, leadership in Diesel construction is naturally expected to be found in this country. There is great economy obtained by converting old-style ships to the internal-combustion type, and the sooner our ship-owners find this out the better for them and for the American merchant-marine. That would seem to be a natural conclusion to draw from the very obvious premises, and yet why all this hesitation?

Insufficient publicity of a general nature is probably one reason for the absence of enthusiasm. No great movement nowadays takes place without a great amount of "advertising." People look for publicity and expect it. The public is even suspicious of occasional statements that are not continuously advertised and paid for in good hard cash. "It is the steady pressing down of the seal that creates the impression," said Edgar Allen Poe, referring to the literary efforts of his day,

Many firms are beginning to realize the necessity for further publicity for the general idea of Diesel construction and equipment and are doing their share in that respect. A sufficient number of firms are "pressing down the seal" to insure u'timate success. The Diesel-engine is here to stay. H. C. R.

VOYAGE OF THE MOTORSHIP "ISONZO."

Regarding the motorship "Isonzo" built in Italy and illustrated in our issue of Nov., 1919, we have received data concerning voyages she has made during the period between Jan. 25th, 1920, and Dec. 15th, 1920, a total of 16,670 nautical-miles having been covered in 1,739 hours, or a mean speed of 9.5 knots. Her voyages are as follows:—

Date 1920	Departure	Arrival	Nautical Miles	Hours
Jan. 25	Genoa	Spezia	45	5
Feb. 9	Spezia	Tunis	455	40
Feb. 18	Tunis	Genca	503	50
Feb. 28	Genoa	Catania	557	52
Mar. 1	Catania	Malta	120	10
Mar. 12	Malta	Genoa	642	67
April 4	Genoa	Spezia	45	5
April 20	Spezia	Songuldak	1378	132
May 16	Songuldak	Genoa	1330	130
June 4	Genoa	Civitavecchia	206	23
June 12	Civitavecchia	Tunis	324	31
June 17	Tunis	Naples	304	31
June 19	Naples	Bacoli	10	1
June 20	Bacoli	Fenoa	332	36
July 21	Genoa	Constantinople	1296	132
July 28	Constantinople	Varna	148	15
July 29	Varna	Sulina (Mouth of the Danube)	180	17
July 31	Sulina	Galatz	80	10
Aug. 1	Galatz	Braila	11	1
Aug. 10	Braila	Constantinople	360	36
Aug. 14	Constantinople	Genoa	1296	137
Sept. 2	Genoa	Sfax	653	64
Sept. 8	Sfax	Livorno	598	63
Sept. 16	Livorno	Civitavecchia	117	11
Sept. 17	Civitavecchia	Sfax	501	50
Sept. 25	Sfax	Genoa	654	72
Oct. 13	Genoa	Marseilles	205	18
Oct. 19	Marseilles	St. Louis, Rhone	22	2
Oct. 22	St. Louis, Rhone	Palermo	508	55
Oct. 25	Palermo	Piraeus	583	73
Nov. 2	Piraeus	Salonicca	274	35
Nov. 4	Salonica	Constantinople	484	61
Nov. 9	Constantinople	Varna	138	16
Nov. 13	Varna	Constanza	115	10
Nov. 15	Constanza	Sulina	100	9
Nov. 16	Sulina	Kilia (Danube)	90	8
Nov. 24	Kilia	Braila	100	12
Nov. 27	Braila	Sulina	90	11
Nov. 28	Sulina	Constantinople	259	27
Nov. 30	Constantinople	Palermo	951	98
Dec. 6	Palermo	Tunis	135	30
Dec. 15	Tunis	Genoa	471	53
			16,670	1,739

Average speed, 9.59 knots.

The motorship "Isonzo" is of 1,600 tons d.w.c. and is propelled by twin Sulzer 420 b.h.p. Diesel-engines of the two-cycle type. There were no break-downs during the entire period.

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Opinions on Naval and Merchant Shipping Matters

THE thirty-second volume of Brassey's Naval and Shipping Annual (1920-1), dealing with Naval matters, will be turned to by all interested in matters of the sea, because of the possibility now of dealing fairly openly with the lessons of the Great War, and of the incorporation for the first time of a section treating of merchant shipping. In no previous issue has the scope been so wide, nor have such a collection of experts of international reputation in affairs of the sea been comprised within one volume. The welding of matters concerning the naval and the mercantile marines is the logical outcome of recent experiences, since in so many matters, not least of all concerning means of propulsion and the latest developments of the oil-engine, reciprocity of experience has been a gain alike to naval as to commercial engineering.

Nevertheless, it is somewhat surprising that no reference is made by any of the Contributors when dealing with war experience to the importance of the question of smoke making and elimination. It is well-known now that many vessels during the war were fitted with apparatus to enable a smoke-screen to be produced, so to hide a change of course to baffle pursuit and to enable safety to be sought. Of perhaps greater importance, still is the question of the elimination of the normal smoke of combustion to which "Motorship" repeatedly drew attention during the submarine campaign period of the war. In many cases undoubtedly the trail of smoke left by steamers gave indication to hostile submarines, of the whereabouts of their prey, as well as often showing the course and speed. As a palliative smoke, smoke deflectors, short funnels and so forth effected a certain improvement. The Diesel motor-ship, however, with its smokeless exhaust has a very great advantage over all steamers—even those with oil-fired boilers—in this important war-time advantage, but none of the men responsible for allied merchant-ship construction took this seriously into consideration with the results we all know of.

The subject of passenger-liners is dealt with by Sir J. H. Biles, who, it is interesting to record, is of the opinion that on account of the increased cost of working the average steamer, reliance for the future must be placed in improved systems of construction. The only hope at present in sight, is truly stated to be the more general adoption of the Diesel-engine. The opinion is expressed that it may be possible before many years, to get enough Diesel-driven engines into one large ship.

In this connection mechanical and electrical gearing between the engines and the propellers are suggested as a possible solution, although it is confirmed that the electrical method will probably not be able to compete either in first cost or weight with the mechanical method. Where the reciprocating oil-engine is concerned with its uneven torque, geared-drive is hardly a satisfied solution, but it is reasonable to hold that any disadvantages of weight and extra cost will be outweighed by the better subdivision of prime movers, the increased reliability of ship, and the greater simplicity of the Diesel-engines installed with the electric system of transmission. Wherever possible the direct drive is to be preferred on the score of simplicity and lower first cost.

Under the heading of "The Sailing Ship's Salvation," Mr. J. W. Eason points out that under present conditions of first costs, fuel and wages, the sailing-ship for certain cargoes assumes a new aspect of attractability. Especially is this the case when more regular sailing is achieved, towing dues are minimised and greater safety under severe weather conditions result from the installation of an auxiliary oil engine. So useful has the oil-engine proved in this field that the decease of the sailer is certainly not yet.

To the marine oil-engine proper is devoted a comprehensive chapter by one of "Motorship's" technical contributors, namely—Mr. James Richardson, B. Sc., of Messrs. William Beardmore & Co., Ltd., Dalmuir, Scotland. This subject which is nearest to the the aims of the "Motorship" is treated evidently with the special purpose in view of convincing shipowners of the economic advantages of the adoption of marine oil-engines for

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Importance of Diesel Motorships in War Time—The Question of Electric Drive—Possibility of Semi-Submerged Diesel-Driven Battle-Ships

marine propulsion. The safety of oil-fuel at sea is proved. The disadvantages of coal are emphasized, an instance of an Atlantic liner, the pre-war speed of which was 18 knots, being reduced to 14 knots, due to bad coal, dirty fires, and difficulties with firemen, etc. The unique economies attained by the adoption of the principles of internal-combustion are only maintained when it is realized that in harnessing such forces to do useful work a higher degree of mechanical ingenuity, and the application of scientific structural design and construction are called for.

On a very conservative basis, it is shown that in costs per ton mile the Diesel-engined ship shows a saving of 70 per cent over the coal-fired steamer and 90 per cent over an oil-fired steamer with triple-expansion engines and 50° F. of superheat. Examples of actual sea-going consumptions are given showing the steamer in less favorable light, and the reason is no doubt to be found in the statement that whereas with steam installation the fuel-consumption is liable to substantial increases consequent upon fouling of the internal heating-surfaces of the boilers, sooting up of the tubes, deterioration of the condenser, leaky glands and valves, erosion in turbine nozzles, increased tip leakage of blades and many other causes. The Diesel engine presents no parallel.

In an appendix to the Shipping Annual are given tables indicating the progress in marine-machinery over the period 1880 to 1920, for various classes of steamers including Atlantic liners, intermediate ocean liners, cargo and cross-channel steamers.

In connection with cargo-steamers of 7,000 s.h.p. the figure for oil-consumption per s.h.p. hour for all purposes of 0.85 lb. with cylindrical boilers working at 200 lbs. pressure and giving superheated steam is somewhat misleading, since this low figure of consumption has not yet been attained to our knowledge in actual service. Similarly with the other figures, it should be emphasized that whilst they represent the ratio of progress, they must be multiplied in many cases by a factor of somewhere about 1.15 in the case of cargo vessels to give actual every day sea-going experience to date with steamers, even those fitted with the best and latest machinery.

Piston-rings and valves with the Diesel oil-engine must be kept clean and tight for safe operation, and with reasonable periodic inspection, cleaning and grinding, the economy is in no way impaired even after years of service. This periodic inspection is necessary apart from considerations of economy of fuel and can be reduced by running the engine at a moderate rating of power output, using a poor quality of fuel-oil and with intelligent operation. The Diesel motor-ship will sail at a higher average-speed due to being immune from questions of boiler condition and operation, and because of the regularity of the propeller revolutions in both calm and heavy weather.

In dealing with the difficulties overcome, Mr. Richardson points out, as has frequently been done in our columns, that the question of the rating of oil-engines is all-important and that it is now realized that for continuous operation at sea the engine must be rated at a definite and reasonably low fraction of the maximum power that can be sustained on the test-bed in the engine-makers' shops.

As with all engineering, the metallurgical side of the problem is being more gradually realized as not the least important, and it is increasingly clear that the future of the high-powered oil-engine is bound up as much with the regular supply of high-grade materials—particularly castings as with any question of design proper. Within the last few years, much earnest research work has been undertaken, and when in time the results and discoveries of such investigations can be translated into practical politics in the foundry, progress will undoubtedly be more rapid and sure.

First cost is an argument against the Diesel-engine. Mr. Richardson states that a 10,000 tons dead-weight capacity 11-knot oil-tanker costs, if fitted with single-screw steam-engines, approximately, 10 per cent. less than does a ship of the same d.w. capacity fitted with twin-screw oil-engines. In a number of cases, however, this 10 per cent. may be reduced owing to the fact that the fitting of oil-engines and absence of large fresh-water tanks, smaller bunkers, etc., reduces the weight and space occupied by the machinery, and so permits of a larger earning capacity from the same size of hull; or alternatively of a smaller ship being able to perform the same duties. The main point, however, is reliability of operation in service at sea.

Details are given of the large fleets of Diesel engined vessels owned by a number of successful shipping companies, to which reference is being made in these columns each month.

Naturally, the subject of the utility of the capital ship commands at the present time considerable attention. This subject has recently been very largely dealt with in the daily and technical press of Britain, France and Italy. In the last named country, it is interesting to record that as a substitute for the "Dreadnought" a design of warship—virtually a monitor—capable of partial submergence for defence and carrying six of the heaviest guns of 15 in. bore has been proposed by Engineer Nabor Soliani. The propelling-machinery is to consist of four twelve-cylinder Diesel engines of 500 B.H.P. per cylinder gives a total per ship of 24,000 B.H.P. and the relatively low speed of 18-knots at normal draught and 1½ knots less when partially submerged. She was illustrated in a recent issue of "Motorship." It is doubtful if this ship is any advance on the British submarines of the "M" Class costing for construction and operation only a fraction of these proposed monitors which, when equipped with two twelve-cylindered Diesel-engines, have the same speed on the surface, are capable of complete submergence, and a fair under-water speed and which carry one 12-inch bore gun.

In Brassey's Annual, Sir George Thurston deals very thoroughly with this absorbing question, and it is interesting to quote his finding—

"It is of course, absurd to suggest the possibility of constructing a capital ship capable of withstanding any offensive effort that might be opposed to it, but speaking from a long practical experience and taking into account the capital vessels of the present day, the lessons of the war, and the possibility of present-day construction and enterprise, the writer is convinced that it is possible to produce a capital ship that would withstand, without foundering, a torpedo attack, that would at ordinary fighting-range remain in action though heavily punished with gunfire, that would have her main and auxiliary armament and her directing officers and staff adequately protected, and that would have a chance to live through any action however severe."

To turn, however, to the present position of Naval engineering, a very thoughtful and constructive chapter is contributed by Engineer Vice-Admiral Sir George G. Goodwin, Engineer-in-Chief of the British Fleet. The great influence in the past of Naval engineering upon mercantile construction and conversely, is described justly and in some detail.

In view of the altered conditions operating at present in Britain, where no warship building is proceeding in private yards, Admiral Goodwin calls for an extended programme of research and experimental work.

A warning note of grave importance is issued, pointing out that experimental and research work is not cheap, and that tangible results are not always immediately forthcoming. Due consideration must be given to the negative as well to the positive results. Research, however, must always prove economical as well as assuring.

Mention has only been made of a small number of the eminent Contributors and their essays, yet sufficient has probably been said to explain the appreciation felt for this comprehensive review of the marine field and of the place therein given to the latest method of propulsion by Diesel-engines, with which we are more directly concerned.

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Injection and Combustion of Fuel-Oil

Experiments With Solid-Injection and Air-Blast in Marine Diesel Engines

By ENGR. COMMANDER C. J. HAWKES, R.N.

PART III.

(*Continued from page* 306, *April*, 1921)

A typical diagram taken from the fuel-injection system is shown in Fig. 9. In this instance the indicator-drum was running at engine speed and the fuel pump at camshaft speed. The pump dead centres are marked by the diagram.

Referring again to Fig. 8, curve "*e*" represents the unbalanced oil-pressure on the valve on the assumptions that the full pressure is acting during the opening and closing periods of the valve, and that the pressure drops uniformly in the system from 4,500 to 3,500 lbs. per square-inch. The former is not, of course, correct for all positions of the fuel-valve but the latter is approximately correct. Curve "*f*" shows a similar curve, but it assumes that the pressure in the system drops uniformly from 3,000 lbs. to 2,000 lbs. per square inch, giving a mean working pressure of about 2,500 lbs. per square inch—which was the pressure for which the system was originally designed.

The critical period is undoubtely when the valve begins to close, and if the full pressure acts on the underside of the valve during this period—and it probably does during the early portion of the closing period—it will be seen that the balance of

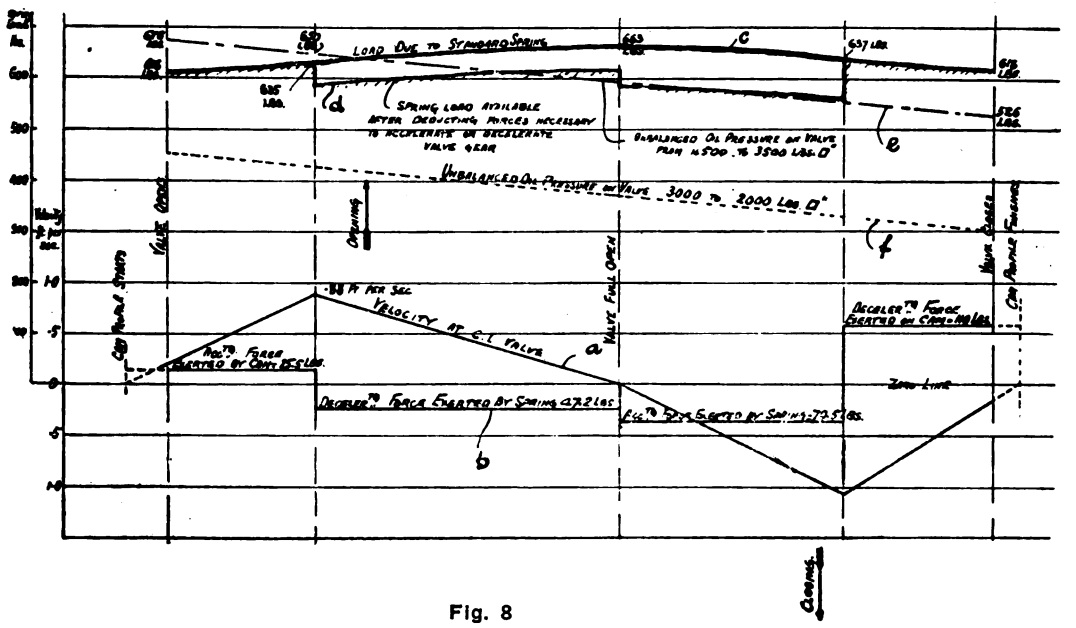

Fig. 8

spring-load available to overcome gland-friction is practically negligible with the higher-fuel pressures assumed. Gland-friction is acting against the spring during the closing period, whilst the unbalanced pressure on the valve is always acting against the spring.

Fuel-valve gland-friction is difficult to estimate in an engine running in Service. In the case of the experimental engine it was ascertained that with the fuel-valve gland carefully packed (and tight) a force of 8.5 lbs. was required to overcome gland friction (diameter of valve spindle 7/16 inch). This should, be regarded as being about the minimum figure. It will be seen that the 618 lb. spring provides only a small margin to overcome an increase in gland friction, or an increased fuel-oil pressure beyond that for which the system was originally designed. So far as spindle friction is concerned the use of a "ground" fuel-valve spindle is an advantage—as a gland is then unnecessary. Difficulties following the adoption of higher pressures can be surmounted by fitting stronger springs or by a further modification of the design.

The 0.016 inch-hole sprayer used in the tests so far recorded was made, as already mentioned, by caulking over the ends of the holes of a 0.019 inch sprayer and then opening out each hole with a tapered reamer to 0.016 inch. This sprayer showed signs of wear, but it was not excessive, although it had been in use for an appreciable time. Later, suitable drills were obtained and the 0.016 inch holes were drilled in a sprayer of the standard shape. After carrying out a number of tests it was found that the best results were obtained with the 0.016 inch-hole sprayer by filing flats in the vicinity of each hole and so reducing the length of each hole to about 1/32 inch. This sprayer was used throughout the tests recorded in Tables 3 and 4, and in subsequent tests, and so far there has been no sign of wear.

It may be of interest to refer to some experiments which were carried out with the object of ascertaining the effect of reducing the lengths of the holes in the sprayer on the quantity of fuel-oil pumped and also on the pressures reached is the system. For this purpose a full-scale model of the fuel-valve and operating mechanism of the experimental engine, complete with fuel pump, fuel-measuring tank, etc., was used. The camshaft is driven by a small electric-motor at a speed corresponding to the engine speed, viz., 190 R.P.M. Valve-lift diagrams can readily be taken, and the fuel can be sprayed either into the atmosphere or into a cylinder filled with compressed-air. This apparatus has proved of the greatest value in carrying out preliminary experiments in connection with fuel-injection.

The results obtained with the apparatus with two sprayers drilled with five 0.016 inch diameter holes, one fitted with flats in the vicinity of each hole and the other without flats, are shown plotted in Fig. 10. The length of each hole in the sprayer with the flats is about 1/32 inch, *i.e.*, about half the length of each hole in the sprayer with no flats.

In Fig. 10 the quantity of fuel-oil pumped per hour (full lines) and the pressure in the system for each sprayer (chain-dotted lines) are plotted against the *effective* pump stroke—the fuel-valve spring being loaded to 750 lbs. in each case. Against each recorded point is a number which represents the total period of opening of the fuel-valve in degrees, obtained from fuel-valve lift diagrams. It will be seen that for the same effective pump stroke the quantity of fuel pumped is greater in the case of the sprayer *with* flats than in the case of the sprayer *without* flats, until the "jumping" of the fuel valve with the latter becomes excessive. It will also be seen that the fuel-valve begins to "jump" when the pressure in the system exceeds about 4,300 lbs. per square inch.

Similar experiments were carried out with these sprayers with a spring loaded to 900 lbs. The effect of the stronger spring was to reduce the "jumping" of the valve with each sprayer, but the fuel-pressures throughout were generally higher and the value of flats was more marked.

A large number of experiments were made with the sprayers under varying conditions, and the results may be summarized as follows:—

(1) It was noticed that the valve-lift diagrams obtained when the apparatus was barred round was shorter with a 900 lb. spring than with a 750 lb. spring—due to a slight deflection of the fuel shaft and lever at the increased spring load.

(2) The difference between the quantity of fuel-oil pumped when spraying into a cylinder filled with compressed air at 430 lbs. pressure and when spraying, with the same sprayer, into the atmosphere was inappreciable.

(3) When pumping the same *weight* of fuel-oil other conditions remaining the same, the pressure in the system when using Broxburn oil of 0.816 s.g. was slightly less than when using shale oil of 0.862 s.g.

(4) It was thought that there might be a slight difference in the results obtained with sprayers drilled with twist-drills and similar sprayers drilled with flat drills. Two sprayers were therefore made similar in all respects, but the holes in one were drilled with flat drills 0.155 inch in diameter, and in the other with twist drills .01575 inch in diameter. The sprayers when tried in the spraying apparatus did not indicate any difference in the amount of fuel-oil pumped, nor was there any difference in the fuel pressure in the system.

(5) The spindle friction of the valve used in these experiments was 15 lbs., *i.e.*, the valve required a force of 15 lbs. to draw it through the packing with the spring removed. (The previous figure mentioned was 8½ lbs.)

(6) When the fuel-pump was pumping with an effective stroke of 15/16 inches against atmospheric pressure only its volumetric efficiency was about 95 per cent. The volumetric efficiency when pumping against the maximum pressure averaged about 75 per cent.

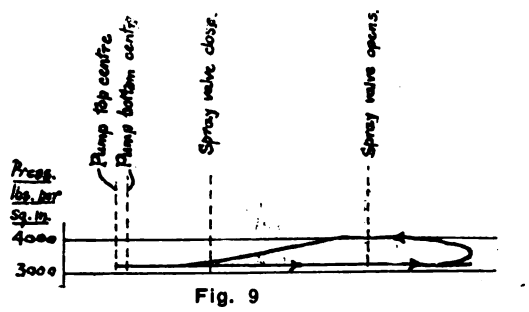

Fig. 9

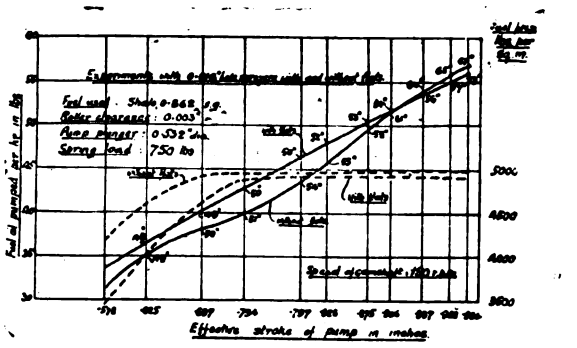

Fig. 10

Although the "jumping" of the fuel-valve is of no great moment, so long as it is not excessive, it should be avoided if possible, especiaaly at high engine-speeds. It can be reduced by reducing the fuel-pressure in the system, but this would mean that the size of the holes in the sprayer would have to be increased. With larger holes, and with a shorter period of injection, it is possible to obtain smokeless combustion at the full power (100 B.H.P.) of the experimental engine, but from the point of view of smokeless combustion at all loads it appears desirable to work with holes in the sprayer as small as practicable—and after many experiments the best all-round results were obtained with the 0.016 inch-hole sprayer provided with flats as described.

(*To be continued*)

MOTORSHIP BUILDING AT NAKSKOV.

It was recently stated in a British publication that the 3,800 tons d.w.c. motorship built at the Nakskov shipyard for the East Asiatic Company is a single-screw vessel. This, however, is incorrect as she will be a twin-screw vessel equipped with two 800 i.h.p. Burmeister & Wain Diesel engines.

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Internal Combustion Engine as Applied to Marine Propulsion

**Paper Read Before the Society of Naval Architects & Marine Engineers, May 26, 1921*

By John F. Metten, Esq., Member, and J. C. Shaw, Esq., Visitor, of the Wm. Cramp & Son, Ship & Engine Building Co., Philadelphia, Pa.

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THE fall in ocean freight rates in recent months to pre-war levels should bring forcibly to the attention of American shipowners the great economic importance of the internal-combustion engine for ship propulsion, although it is not claimed that the Diesel engine is a complete remedy for the present predicament of the American merchant-marine. The situation in which American shipping now finds itself is analogous to the early transition from sail to steam. This country then failed to keep pace with Great Britain, who gained a lead which was only partly overcome, due to the condition brought about by the late war.

"Motorship's" Warnings

In the recent shipbuilding emergency, efficiency of type was subordinated to the expediency of rapid construction and quantity production. **Many warnings were sounded to those in authority at the time in regard to the danger of entirely ignoring the larger motorship in the emergency construction.** However, this defeat in building could have been greatly remedied by recasting the uncompleted program immediately after the armistice, as carried out by other countries, to meet the inevitable competitive conditions of peace.

Contrasted with our past policy in reference to motorships is that of Great Britain and Scandinavian countries in particular who fostered the motorship during the war, and, since the armistice two-and-a-half years ago, have rapidly built motorships almost to the exclusion of the less efficient steam cargo-vessels.

What to do With Present Fleet

As matters now stand we find ourselves in the possession of a large government-owned fleet, almost wholly steam driven, which private owners are reluctant to purchase or operate. The question accordingly is presented to us, as naval-architects and marine-engineers, as to the best method by which the inadequacy of the situation can be met, whether to advocate the conversion of the most inefficient of the existing steam-vessels to Diesel-drive or build new motorships, and the best systems to be recommended.

It is hardly necessary to state in detail the particular advantages of the motorship over the steamer which are fairly well conceded and undoubtedly well known to the members of the Society. More in regard to detail of the application of the internal-combustion engine, pointing out the various advantages and the defects of the different systems, will be attempted to be presented. A critical analysis of two vessels of a given size, propelled by steam-turbines and Diesel-engines, will also be given to show the economic importance of the latter. It is to be hoped the authors will be pardoned if undue reference is made to Burmeister & Wain, of Copenhagen, with whose work they are mostly familiar.

A Huge Fleet of B & W Motorships

As commonly recognized, this pioneer company has been mostly responsible for the present accepted high standing of the motorship. There will be completed this month sixty-seven vessels to their system representing 580,000 tons deadweight and 214,000 Diesel indicated horse-power, totaling more tonnage than all the other makers combined for this class of vessel. Of other continental builders who have done much also to promote development of the motorship with their respective designs may be mentioned Werkspoor, Sulzer, Ansaldo San Giorgio, Krupp, Polar Diesel and Vickers of England.

A brief review of Burmeister & Wain's work in this field will be given. This maker, like Werkspoor, has always held to the four-cycle engine as best suited to this class of service, where utmost reliability combined with economy is of first consideration.

Their epoch-making first vessel, the Selandia, was put into service in February, 1912, being 7,400 tons deadweight, having twin screws, and designed for 10½ knots. The two main engines, which have eight cylinders each, develop 2,500 total indicated horse-power when running at 140 revolutions per minute. This vessel, now entering her tenth year, with a total mileage of nearly 500,000, has proven the same unqualified success as her successors**and is today in steady service, while hundreds of steamships completed eight years later are laid up on account of their greatly inferior operating economy.** Eight cylinders were used to limit the diameter to 530 mm., or 21 inches, which was the same as Burmeister & Wain's largest land engine at that time. Later the number was changed to six, which is cheaper to build, requires less engine-room length and has fewer parts to take care of. The size of the cylinders was increased by degrees to meet the power requirements of the larger vessels employed. The largest cylinders so far built by this company are 740 mm., which is six and eight cylinders give respectively 4,500 and 6,000 indicated horse-power for two screws, turning at 115 revolutions per minute, and suitable for cargo vessels of, say, from 11,000 to 14,000 tons deadweight and 12 to 12½ knots speed. The six-cylinder engine is the same as is being installed by the Cramp Company in the United States Shipping Board's motorship William Penn, shortly to be placed in service.

A Large B & W Engine

It might be mentioned that the same Danish builder has drawings completed for Diesel-engines having cylinders of 800 mm. or 31½ inches diameter, and 500 indicated horse-power per cylinder adaptable to intermediate liners. As with the steam-engine, there is a limit in size of cylinder for a Diesel-engine, and it would appear that the 31½-inch is nearing this limit, due principally to liner thickness required. Considerations of convenience for handling the parts on board vessel are also involved. It would seem that the next logical step with the four-cycle engine for increasing the power to more than 500 indicated horse-power per cylinder is to resort to the double-acting piston. From the standpoint of elimination of heat troubles, the condition is believed to be more favorable for the double-acting four-cycle engine than for the single-acting two-cycle engine, as the maximum temperature at the first part of the power strokes is alternately distributed to the two ends instead of continually to one end of the cylinder as with the two-cycle.

The adaptability of the motorship in having its auxiliaries electrically driven, and the advantages resulting from the same, were at the beginning recognized by Burmeister & Wain and incorporated in their first vessel. As the internal-combustion engine by nature requires an external source of power for starting and maneuvering, the same power can be effectively used for other purposes as for driving pumps in engine-room and deck machinery. The saving in fuel thus made, being about one-tenth that of a steam-vessel when in port, it should be observed, is due primarily to the efficiency of the Diesel-engines driving generators and not so much to the electrical transmission as some have been led to assume.

Systems for Auxiliaries

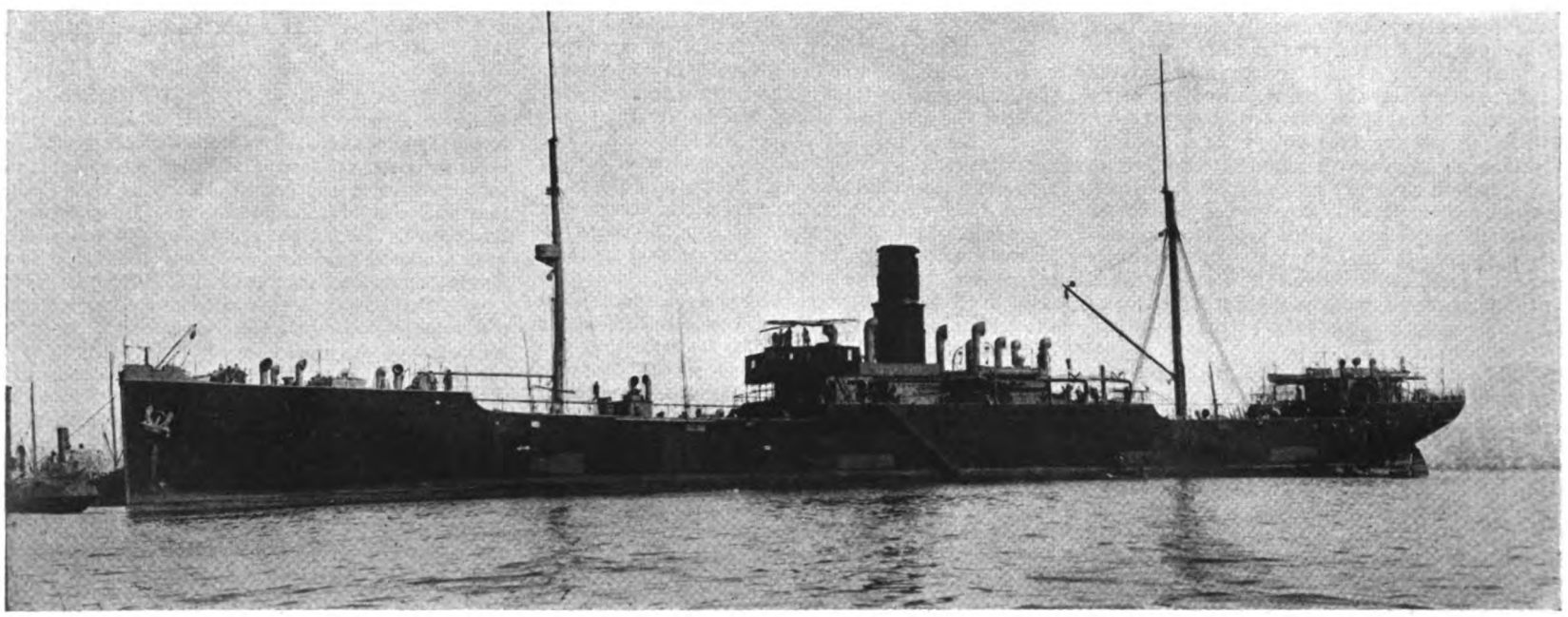
In the early installations two large auxiliary engines were used, each driving a generator and compressor in tandem, the latter being uncoupled when in port. This was soon replaced by three, and now, as in some of the larger vessels, by four, small sets having generators only. The compressors on the main engines at the same time were changed from single high-stage compressors, taking their air from the maneuvering air system to independent three stage compressors. For the two low-pressure air-compressors, one of which was always operated at sea, was substituted one motor-driven compressor for maneuvering purposes only. This latter arrangements is better in that the high and low-pressure air systems are not interdependent and the auxiliary power-plant is more flexible. From an operating standpoint it is also better, as by having more than two sets and being small in size, they can be overhauled in turn at sea, relieving the work of the engineers' personnel in port, whose time should then be given to more important port duties.

Two-cycle or Four-cycle

There has been much discussion as to whether the two or four-cycle engine is better. Judged in the light of the number of motorships in successful operation, at present the four cycle has the decided advantage. The special claims made for the two-cycle engine is that more power can be obtained per cubic space of cylinder, from having double the power strokes of a four-cycle, and hence less weight and space occupied; also that the two-cycle, having no exhaust-valves to cause trouble, can burn the lower grade oils of high sulphur content.

The four-cycle advocates dispute these claims by saying that the two-cycle engine cannot run with as high mean pressures in the cylinders as the four-cycle if internal heat troubles are to be avoided, and that the combustion is not apt to be as complete as in the four-cycle. They also point out the lower mechanical-efficiency, resulting from negative work required for scavenging, and hence higher fuel-consumption. With the rings passing across the open ports wearing conditions are not so good as with the unbroken liner surface of the four-cycle, and the cylinder lubricating-oil consumption is much higher than the four-cycle due principally to the oil being scraped into these ports and blown-out through the exhaust. It is also stated that with the long pistons required, scoring is apt to result from misalignment caused from wear at crossheads and guides. The two-cycle originally dominated the field of the light high-speed submarine engine, but after some ten years have been spent in its development it has been superseded in this field to a great extent by the four-cycle. This would not have been possible if there is any inherent advantage in the two-cycle as to weight for a given output. Moreover, in the long trade routes, which is the merchant motorship's chosen field, it must be obvious that the conceded superior economy of the four-cycle will give an advantage in cargo-capacity more than sufficient to offset the advantage in weight of machinery claimed, but not yet proved, by the two-cycle advocates.

Some makers, who originally built four-cycle engines and changed to two-cycle, have in recent years changed back to four-cycle, and others, who have always built the four-cycle, are known to be experimenting with the two-cycle. All experienced builders are fairly well agreed, however, that the Diesel-engine works best at low speeds due to the nature of the injection and burning of the oil, and that the large cylinder engines better burn the lower-grade oils. Oil of higher sulphur content, though, as commonly used under boilers, is not to be recommended, as the sulphuric acid formed in the burning not only affects adversely the exhaust-valves of the four-cycle engine



"Giove," a Diesel-driven oil tanker of the Royal Italian Navy. Displacement, 10,310 tons; capacity, 6,000 tons; length, 416½ ft.; breadth, 50¾ ft.; draught, 24 ft. She is fitted to carry six 14 pounder guns in war time.

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but attacks impartially the exhaust-pipes and other parts of either the four or two cycle.

Solid or Air-injection

Some makers have advocated the solid-injection (injection of the fuel by pressure alone,) with which Vickers has been most successful. The chief difficulties encountered with such a system are in getting good combustion at all running speeds and loads and the elimination of the shock in the cylinder, which is apt to occur with the sudden rise in pressure when fuel is injected. The advantage claimed is that compressor troubles are entirely eliminated with a correspondingly higher mechanical efficiency obtained than with air injection. The fuel-consumption, often erratic, however, under the most favorable conditions, is no better than the air-injection Diesel. It is also questioned if an oil-pressure from 2,500 to 4,000 pounds per square-inch is more to be preferred than an air-compressor and its corresponding air system having a pressure of 850 to 900 pounds.

Disadvantages of Diesel-electric Drive

The Diesel-electric drive has been suggested by some, using direct-current supplied by several high-speed engine sets working in series. The sponsors of this system apparently have either taken their cue from the turbine-electric drive or are more familiar with the electric end than the shortcomings of the high-speed Diesel-engines. To reduce the weight of the engines and space occupied sufficiently to compensate for the additional electrical equipment involved, the engines must necessarily be high speed and of the trunk piston type. The engines would correspond in design to that halfway between land and submarine practice.

The disadvantages of such a system compared with the direct drive are as follows:

(1) Loss in reliability in the prime movers.

(2) More major overhauls. as lifting of cylinder covers and drawing of pistons, due to poorer combustion and passage of lubricating oil from crank case.

(3) About 30 per cent more fuel per knot, 15 per cent chargeable to higher fuel-consumption of engines, and at least 15 per cent electrical losses with the small-size generators used.

(4) Lighter grade and more expensive fuel-oil required.

(5) Much higher lubricating-oil consumption associated with high-speed and trunk-pistons.

(6) Possible vibration troubles associated with high revolutions.

(7) Necessity for using objectionably large motors of the commutator type for transmissions of power from engines to propellers.

(8) Greater complication of controls and more expert knowledge required of the engineer personnel.

(9) Tendency to overwork the personnel with the frequent overhauls required with high-speed engines when operated continuously at full power.

(10) Danger of short circuits.

(11) Short life of high-speed engines compared with slow-speed engines.

(12) Higher first cost and maintenance charges.

With the higher consumption of fuel and lubricating-oil per indicated horse-power combined with the electrical losses involved and the better quality of fuel-oil required, the total expenditure for these items will be about 50 per cent more than with the direct-drive system.

Converting Existing Steamers

The Diesel-electric system has been specially recommended for converting existing steamers. It is believed by the authors that this can be far better accomplished by using a long-stroke engine turning at the low revolutions required. Work has been done along these lines by Doxford and Cammell-Laird, using the doubled opposed-piston, and also Burmeister & Wain have developed a line of long stroke engines. with a stroke bore ratio of two to one, specially adapted to single-screw vessels. These latter engines are to be recommended for new vessel, as well, of 5,000 tons deadweight and less, on account of less engine-room personnel required, important in small vessels, and the dispensing with one shaft alley, which is also important in this size ship.

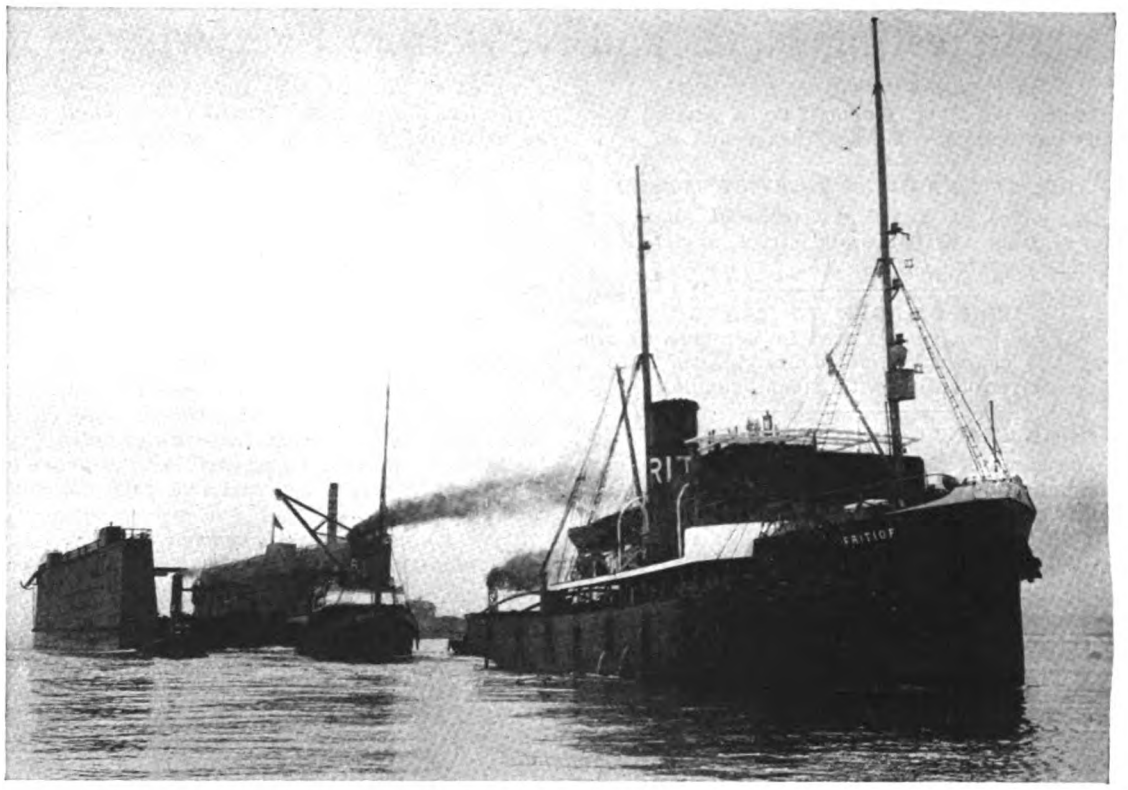
For new motorship construction, over 5,000 tons deadweight two screws are to be recommended. In smaller vessels there is little difference in propulsive efficiency between single and twin screws. For larger ships, however, the efficiency is more favorable with the two-shaft arrangement due to well-known conditions affecting propeller performance, including the better immersion of the two smaller propellers under all conditions of draught. In the larger vessels, also, the saving in space by having only one shaft alley is not so important, and the length of engine room will be less with the higher-speed standard-stroke engines.

Motorship Versus Steamship

A comparison will be given showing the estimated increased earning capacity of a motorship over a corresponding oil-burning steamer as can be anticipated in actual service. The size of vessel chosen has the same general dimensions as the motorship Afrika, owned by the East Asiatic Company, and which is similar to the "William Penn" and the two motorships building for the United American Lines.

The steamer is single screw with double-reduction gearing and compound turbines and Scotch boilers. The revolutions for the propeller is taken as seventy, which is conservative practice, to favor propulsive efficiency which for convenience here is assumed the same as the twin-screw vessel.

The ships are of the awning-deck type having a nominal deadweight carrying capacity of 13,000 tons when loaded to 31 feet 5 inches draught. They are 445 feet between perpendiculars, 60 feet beam and 42 feet moulded depth, with a block coefficient of .782. The shaft horse-power of the turbines is taken as 3,500 which is equivalent to the 4,500 indicated horse-power of the Diesel-engines. The cost of the vessels to build, based on probable cost of labor and material in the immediate future, is assumed $150 per ton for the steamer and $165 for the motorship. The $200,000 additional cost of machinery for the motorship, including deck machinery, is considered fair where the Diesel work is well standardized.



Diesel-driven salvage-vessel "Fritiof," built and engined by the Götaverken, and was fully described in our issue of December, 1920. She is propelled by B. & W. type Diesel engines.

Great Difference in Fuel-consumption

The fuel-oil consumption at sea for the steamer with 16° Beaumé oil is taken as .95 pounds per shaft-power, all purposes, which should be realized in service with properly designed turbines and double reduction gears and coordination of auxiliaries. For the motorship, with oil of 22° Beaume, the consumption is taken as 0.31 pounds per indicated horse-power all purposes, which is usual with motorships belonging to the East Asiatic Company. The cost of oil in American port, per recent quotations, is $2 for fuel oil for steamer and $2.30 for Diesel-oil of gravity indicated. It is necessary for the steamer to take on additional oil in a foreign port which is assumed double that in an American port.

The route chosen is from San Francisco to the Far East and return, calling, for example, at Yokohama, Hong Kong, Manila and Honolulu, with a total distance of 15,500 knots. The number of days at sea and in port is taken from percentages for similar vessels operating over similar routes, and the number of days in port include that for loading and unloading, repairs and docking, holidays, etc.

The cost of personnel is based on scale of wages in effect the first part of this year with sustenance at $1.25 per man. This is estimated with 27 for the deck officers and crew for either vessel, and for the engine room 19 and 14 men respectively for the steamer and motorship.

The freight rate for bulk cargo is estimated as $27 per 100 cubic feet and for deadweight cargo as $13.50 per ton which is fairly well in accordance with present rates.

The itemized figures are as follows:

	Steamer	Motorship
Displacement, (tons)	18,690	18,730
Gross tonnage, (tons)	9,050	9,050
Actual mean sea speed, knots	11.5	11.5
Revolutions per minute	70	115
Indicated horse-power	....	4,500
Shaft horse-power	3,500	....
Total weight of machinery (tons), including pipes, ventilators, ladders, floor plates, spares, tools, outfit, propellers, shafting, etc.	690	911
Water in system, (tons)	115	14
Weight of deck machinery, (tons)	140	155
Weight of hull, fittings, equipment, etc., (tons)	4,575	4,600
Light displacement, (tons)	5,520	5,680
Capacity deadweight, (tons)	13,170	13,050
Capacity (bales) cubic feet	590,000	620,000
Oil bunker capacity, tons (double bottoms)	1,320	1,350
Oil-bunker capacity, tons (tank between tunnels)		120
Oil-bunker capacity, tons (settling tanks)	80	20
Total oil-bunker capacity, (tons)	1,400	1,490
Oil consumption per shaft horse-power, main engines all purposes, pounds	.95	....
Oil consumption per indicated horse-power, main engines, all purposes, pounds	.....	0.31
Oil consumption per day at sea (tons)	35.65	14.95
Oil consumption per day in port, (tons)	5.5	0.7
Number of days at sea, per annum	220	220
Number of days in port, per annum	145	145
15,500-Knot Voyage		
Days at sea	55.5	55.5
Days in port	36.5	36.5
Total oil consumption at sea, (tons)	1,980	830
Total oil consumption in port, (tons)	200	26
Reserve oil-bunker (for about six days), tons	220	90
Total oil carried outbound, (tons)	1,400	946
Total oil burned on trip out, (tons)	1,090	428
Total oil necessary, homebound, (tons)	1,310	518
Oil to be purchased abroad, (tons)	1,000	0
Weight of crew and stores, (tons)	50	50
Fresh water on board at start of each leg, (tons)	300	75
Total weight of vessel, including fuel, water, etc., outbound, tons	7,270	6,751
Total weight of vessel, including fuel, water, etc., homebound, (tons)	7,180	6,323
Cargo-capacity, outbound, (tons)	11,420	11,979
Cargo-capacity, homebound, (tons)	11,510	12,407
Cargo capacity, average (two ways), tons	11,465	12,193
Cost of Operation Per Voyage		
Insurance (4%); depreciation (5%), 92 days	$44,200	$48,800
Brokerage, at $0.15 per ton cargo capacity	3,440	3,660
Overhead and general expenses at $20 per gross ton, per annum	45,600	45,600
Fuel oil	45,900	15,260
Water, at $1 per ton	600	150
Deck officers, crew, stewards	12,200	12,200
Engineer personnel	9,300	7,600
General stores, deck, engineers and stewards	5,000	5,000
Totals	$166,240	$138,270
Loading and discharging of deadweight tons at $1 per ton and 75% of cargo capacity	$17,200	$18,280
Total cost for deadweight cargo (per voyage)	$183,440	$156,550
Loading and discharging of bulk cargo at $2 per 100 cubic feet at 75% capacity	$17,700	$18,600
Total operating cost for bulk cargo (per voyage)	$183,940	$156,870
Comparison of Earnings With Deadweight Cargo Carried		
Tons per voyage outbound at 75% capacity	8,580	8,980
Tons per voyage homebound at 75% capacity	8,640	9,300
Rate per ton	$13.50	$13.50
Gross revenue per voyage at 75% capacity	$232,500	$246,780
Cost of operation per voyage	$183,440	$156,550
Net revenue per voyage	$49,060	$90,230
Net revenue per annum	$195,000	$358,000
Per cent earned on investment	10	16.65
Comparison of Earnings With Bulk Cargo		
Cubic feet of cargo carried out and return at 75% capacity	885,000	930,000
Rate per 100 cubic-feet	$27	$27
Gross revenue for bulk cargo	$239,000	$251,100
Cost of operation per voyage	$183,940	$156,870
Net revenue per voyage	$55,060	$94,230
Net revenue per annum	$218,500	$374,000
Per cent earned on investment	11.2	17.4

From the foregoing it will be seen, for the particular conditions chosen, that the motorship has an increased earning capacity over the steam-vessel of 66 per cent on deadweight and 55 per cent when bulk cargo is carried. In addition to the bulk cargo, there can be carried on the outbound trip 544 tons of oil, which at $13.50 per ton, will increase the amount earned on investment from 17.4 per cent to 18.73 per cent, or 67 per cent better than the steamer. The above figures can be used as a basis for working-out a comparison for any route which will vary directly with length of voyage and the size of the vessels employed.

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Interesting Notes and News from Everywhere

IS IT AN AMERICAN RECORD?

To-date the New London Ship & Engine Company has built 450 Nelseco Diesel-engines.

OUR SAN FRANCISCO OFFICE MOVED

Our office at San Francisco, Cal., has been moved from 149 California Street to 417 Montgomery Street.

FROM CRUISER TO TANKER

Plans have been prepared in Germany to convert the cruiser "Ersatz Leipzigklasse" into a Diesel-driven tanker with steam auxiliaries.

"F.H.HILLMAN" CHANGED TO "H.T.HARPER"

The name of the Werkspoor-Diesel tanker now completing by the Moore Shipbuilding Co. of Oakland, Cal., has been changed to "H. T. Harper."

FIVE BRITISH-BUILT WERKSPOOR ENGINES

The North Eastern Marine Engineering Co., Ltd., of Newcastle-on-Tyne, are constructing five Werkspoor-Diesel marine-engines of 1,400 i.h.p. each.

GERMAN MOTORSHIP "HELENE JENSEN"

The Vulcan Shipbuilding Co. of Stettin, Germany, have completed and delivered the motorship "Helene Jensen" to the order of the shipping firm of F. J. Jenson & Co.

SMALL GERMAN MOTORSHIP

A shipping company at Stettin, Germany, has just been placed into service a new 600 d.w.c. Diesel motorship of 300 b.h.p. Further details are not yet available.

MOTORSHIP'S GOLD CARGO

With 227 boxes of gold specie value over $6,000,000 on board, the Swedish 7,500 tons d.w.c. motorship "Stureholm" recently arrived in New York. She has frequently been illustrated in "Motorship."

EIGHT 6,000 TONS MOTORSHIPS FOR HAMBURG-AMERICAN LINE

A fleet of eight 6,000 tons gross Diesel-driven motorships has been contracted with Blohm & Voss of Hamburg, Germany, by the Hamburg-American Line.

BLOHM & VOSS MOTORSHIP, "LEOPOLD DAVID"

The cargo motorship completing at Blohm & Voss's yard, Hamburg, Germany, has been named "Leopold David." Double-acting two-cycle type Diesel-engines are being installed.

OIL-ENGINED DREDGER BUILDING

Now completing at San Francisco, Cal., to the order of the Conway Ranch Co., Woodland, Cal., is a dredger for canal work. A 60 b.h.p. Fairbanks Morse heavy-oil engine is being installed.

PETTER ENGINES IN ROYAL ITALIAN NAVY

We are advised by the Ministry of Marine that now under construction for the Royal Italian Navy is a small tanker for local service named "Arsa," in which Petter surface-ignition oil-engines are being installed

DIESEL-DRIVEN CANNERY TENDER

Recently launched at Schertzer Bros. Shipyard, Lake Union, Wash., was the 65-ft. cannery-tender "Grisby II," which is having a 100 b.h.p. Enterprise solid-injection type Diesel-engine. Her owner is Frank N. Nordland.

REGISTER OF ISHERWOOD SYSTEM SHIPS

Just as we close for press we received a very handsome volume from J. W. Isherwood, the well-known naval-architect, the same being a register of vessels built on the Isherwood system, including the years 1920 and 1921. We are obliged to hold over a review of this volume until our next issue.

HAMBURG AMERICAN LINE AND DIESEL ENGINES

In the shipyards and engine construction of the E. G. Deutcher Werft and Gutte Hoffnungshutte, w building Burmeister & Wain Diesel-engines d motorships, the Hamburg-American Line has acquired an interest, says Dr. Cuno, who recently arrived in the U. S. A. Details of orders on hand appeared in "Motorship" of January and March last, and also elsewhere in this issue.

DIESEL ENGINE ON S.S. "ARUNDEL CASTLE"

The new Union Castle passenger liner, "Arundel Castle," is equipped with a 75 K.W. Diesel-electric generating set on deck for emergency light and power.

OIL-ENGINED TUG FOR PUGET SOUND

The Pacific Creosoting Co. recently accepted delivery of a 53-ft. tugboat powered with a 100 b.h.p. Fairbanks-Morse surface-ignition oil-engine, built by the Ballard Maine Railway. A speed of 10½ m.p.h. was attained, and the craft will work on Puget Sound.

KINCAIRD'S B. & W. DIESEL LICENSE

Previously announced in "Motorship" an official announcement has recently appeared in the British marine-press to the effect that John G. Kincaird & Co., of Greenock, Scotland, has acquired a Burmeister & Wain Diesel sub-license from Harland & Wolff.

ANOTHER CAMMELLAIRD-FULLAGAR LICENSE

The English Electric Company, which incorporates a number of large British engineering companies, has acquired a Cammellaird-Fullagar license, and an engine of 750 b.h.p. in six-cylinders is being built at Willans & Robinson's works at Rugby.

"ROSANA," A COSTA RICAN MOTOR-VESSEL WITH AMERICAN OIL ENGINES

We recently referred to a 300 tons d.w. freight and passenger cargo-vessel named "Rosana," owned by the Empresa de Navegacion Centro-Americana Puntarenas (Alberto Fait & Company). She is of particular interest, as she is propelled by twin 75 b.h.p. Western Diesel engines, and the

craft has been in service since June, 1920. It is understood that this vessel is operating between Puntarenas and the Panama Canal. In a letter to the engine-builders from the owners of the ship, they stated that returning from Costa Rica to Panama they had a splendid trip averaging 8 miles per hour, and that in 62 hours of continuous navigation running the engines at 300 to 320 r.p.m. only 720 gallons of oil was used, part of which was lost on account of heavy balancing of the boat.

DESTROYERS "WHIPPLE," "WORDEN," STEWART," PERRY" AND "TRUXTON" CONVERTED TO MOTOR POWER

Five old U. S. destroyers have been converted to motor-power by the E. R. Clinton Shipbuilding & Dry Dock Co. of Philadelphia, Pa., to the order of M. Snyder of New York. These vessels are the "Whipple," "Worden," "Stewart," "Perry" and "Truxton," and each has been fitted with twin 200 b.h.p. Wolverine engines. Two of them are engaged in the fruit-carrying trade between Gulf ports and Houston, Texas, while the "Truxton" has left for Bluefields on April 29th with the Nicaraguan flag as its national emblem. Further particulars are not available at the present time.

TWO NEW 1,000-TON MOTORSHIPS PROPOSED

Preliminary plans for the construction of two 1,000-ton d.w.t. motorships are being prepared by Seabury & de Zafra, Inc., 150 Nassau Street, New York City, who have been commissioned by clients to provide for most up-to-date vessels in every way. These vessels will be of steel construction operated by Diesel-engines, and all auxiliaries will be electrically operated. A speed of 11 knots is to be provided. There will be accommodations for 25 first-class passengers. It is not expected that the order will be placed before next Fall.

——Says the "MARINE JOURNAL"

With the release of the New York Barge Canal from Governmental control, that waterway is to have a miniature merchant-marine of its own, privately owned and operated. Introduction of Diesel-powered barges in large numbers will bring one branch of American shipping abreast of the times. When Government control goes, the motorship comes.—"*Marine Jourarl*," April 30, 1921.

MOTORSHIP "TOSCA" OPENS NEW LINE

Representatives of the "La Campagnie Russe de Navigation" a Vapeur et Commerce have been visiting the Levant ports for about six months to organize a new line, and the motorship "Tosca," described in our issue of April, 1921, recently loaded at Hamburg and sailed for the Levant. Winge & Co., Christiania, are the managers of this line. Their new motorships "Geisha" and "Indra" will be delivered this and next month, respectively. All the ships are Werkspoor-Diesel propelled.

CAST-IRON FOR INTERNAL-COMBUSTION ENGINES IN THE PHILIPPINES

Existence of large deposits of magnetic iron-ore has been discovered near the Abo-Abo river in the Bataan and Pampagne provinces, Philippine Islands, and probably will be worked and explored by the Bataan Power Co., who are installing a hydro-electric power station. This iron stands a high degree of temperature, and is said to be very suitable for cast-iron for internal-combustion engines. Further information should be obtained from the Bureau of Comemrce of the Philippine Islands, 280 Broadway, New York City.

A 300 H.P. MOTOR-TUG FOR PHILADELPHIA

A 300 h.p. motor-tug has been designed for the Diamond P Boat Line of Philadelphia by E. A. Edwards, naval architect in the Marine Department of Fairbanks, Morse & Co., Philadelphia, Pa. The boat is intended principally for inland coastwise towing and consequently was limited to 7 ft. draft. The principal dimensions are as follows:

Length, O. A.	82′ 6″
Breadth, moulded	16′ 6″
Depth, moulded	9′ 0″
Draft	7′ 0″
Shaft H.P.	300

She will be fitted with a 300 b.h.p. Fairbanks-Morse oil-engine of the two-cycle type.

WAR DEPARTMENT'S 39 CONCRETE MOTORSHIPS

We understand that the fleet of concrete motorships, in which eighteen Union 300 b.h.p. distillate-oil engines, were installed by the U. S. War Department, have been giving excellent service at the various assigned stations on the Atlantic Coast. Details of these unique craft were published in "Motorship" for September and December, 1918. Altogether there were 32 motor craft, some having other makes of engines. Very shortly the first of the fleet of seven new twin-screw 1,000 b.h.p. concrete passenger-cargo motorships building for the War Department will be ready. Winton Diesel-engines are installed.

STEEL CASTINGS FOR AMERICAN-GERMAN DIESEL ENGINES

For the Augsburg (German) type submarine Diesel-engines of 3,000 b.h.p. building by the U. S. Navy Department, difficulty was encountered in getting domestic steel foundries to undertake to produce the necessary steel castings, so they have been made at the League Island Navy Yard, Philadelphia, with electric furnaces. A three-ton furnace was employed, and experimenting indicated that the trick is in the coring. The steel is poured into the mold and the minute that the metal has set the mold is broken down to get the casting out. The cores are destroyed so that the casting cannot shrink on a stiff hard core. In some of the difficult castings the core is made so that it will crush, and, so far, the results have been satisfactory.

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BIG AMERICAN MOTOR-LINER TO BE BUILT

Plans for an 18-knot Diesel-motor passenger-liner to carry 2,000 people are being prepared for the Puget Sound Navigation Co., of Seattle, Wash.

ANOTHER PACIFIC COAST MOTORSHIP

Now under preparation by Ted Geary, the Seattle naval-architect, are designs for a Diesel motorship of approximately 2,400 i.h.p. to the order of the Puget Sound Tug Boat Co.

SHIPPING BOARD MAY GET ABOUT $60,000,000

In the efficiency appropriation bill passed by the House of Representatives on May 26th, was included $61,852,000 for the U. S. Shipping Board. It is anticipated that this will also be passed by the Senate.

PROPOSED DIESEL-ELECTRIC FERRY FOR SAN FRANCISCO

The Golden Gate Ferry Co. are considering building a Diesel-electric ferry-vessel for operation between San Francisco and Marin County. Plans have been prepared by D. W. & R. Z. Dickie and two 450 b.h.p. Winton engines in conjunction with Westinghouse electrical equipment will be installed if the order is placed. Harry E. Speas is the president of the Ferry Company.

LLOYD'S MOTORSHIP-BUILDING RETURNS

Returns of British motorship construction for the first quarter of 1921 have just been issued by Lloyd's. The listing of oil-engined vessels under construction on March 31st, are very interesting, and tally very closely with the figures recently given before the U. S. Senate committee by Mr. W. Denman. The totals are as follows:

	No. of ships	Gross tons
Steel Motorships	60	260,731
Concrete Motorships	4	2,094
Wood & Composite Motorships	2	355
Totals	66	263,180

This means a deadweight-capacity tonnage of approximately 418,639 tons, or an average of 6,343 tons d.w.c. for each of the 66 motorships. Mr. Denman stated that on Dec. 1, 1920, there were 65 ships of 583,600 tons d.w.c. actually building in Great Britain, but he did not list any vessel smaller than 1,200 tons d.w.c., and several large vessels have since been launched, so are not included in Lloyd's figures. Therefore, his list was faily accurate.

The above list is sub-divided into the principal towns where the craft are building, but some towns are not included, so only 61 boats given in the following list, viz.:

Town	Country	No. of ships	Gross Tonnage
Aberdeen	Scotland	1	150
Barrow	England	5	34,445
Belfast	Ireland	2	11,600
River Clyde	Scotland	27	173,630
*Dundee	Scotland	2	600
Hull	England	1	227
Leith	Scotland	1	3,845
Liverpool	England	8	2,612
Newcastle-on-Tyne	England	5	12,081
Southampton	England	6	1,480
Sunderland	England	3	15,500
Total		61	256,170

Obviously, it does not include the 15,000 tons B. & W. Diesel-driven motorship building by the Caledon Shipbuilding Company of Dundee, Scotland, for the Ocean Steamship Co. of Liverpool, so probably her keel had not been laid by March 1st. Seventeen of the above motorships are of between 6,000 and 8,000 gross tons, and nine are between 8,000 and 10,000 gross-tons, without including the Caledon 15,000 tons vessel. Five are between five thousand and six thousand tons gross.

LAUNCH OF DIESEL-TANKER "SCOTTISH STANDARD"

On April 8th the launch took place of the first of the four Diesel-driven tankers now building at Vickers Ltd., Barrow, to the order of Tankers, Ltd., London. She is of 10,050 tons d.w.c., 14,050 tons loaded-displacement, and is propelled by two 1,250 shaft h.p. Vickers solid-injection Diesel-engines. That is to say, she is practically a duplicate of the Vickers Diesel-driven tankers "Narragansett" and "Seminole" owned by the Anglo-American Oil Company.

After the launch, Sir James McKechnie stated that the new vessel expressed in a practical manner the recognition by a progressive company of what has undoubtedly proved itself to be the most economical mode of sea-going propulsion, and that the internal-combustion engined ship has come to stay. Also, that the "Scottish Standard" typifies the latest Vickers design, and includes all the improvements suggested by the merit of science and the ocean experience they have gained to date from the "Narragansett." The fuel consumption of the latter was 9 lbs. of oil per thousand tons per mile traversed.

Mr. Douglas Stewart, Managing-Director of Tankers Ltd., referred to the "Scottish Standard" as being an oil-transport de luxe of exceptional size and with exceptional machinery. He said that he must confess he had been skeptical about the class of engines installed in their new ship, but after witnessing the success that has attended the "Narragansett," and which would have been greater if the "Narragansett" had been burning the special Anglo-Persian Diesel-oil, all his prejudices are disappearing and that they may look forward with confidence to even finer results with the "Scottish Standard" than have been obtained with the "Narragansett."

Continuing, Mr. Stewart said, "We have four of these motorships building, and had the times been more prosperous, there is no reason why it should not have been eight." He then referred to the drop in freight and oil, from 80 shillings per ton in November to 20 shillings per ton to-day, and then said he was confident when many of the steam-driven oilers are unable to run, the "Scottish Standard" with her economical Diesel-engines will be able to keep to the water, and fly the flag they desire to keep flying.

The motorship "Hoisdorf," converted from the German destroyer "H. 186," together with the "H. 187," to Diesel power

TWO GERMAN TORPEDO-BOATS CONVERTED INTO MOTOR-FREIGHTERS

"Beating swords into ploughshares" is not exactly a sea-going term, but we are strongly reminded of it in considering the reconditioning job which has been carried out with the German torpedo boats H-186 and H-187 as described in the April issue of "Werft und Reederei" by chief-engineers Mau and Lange, of Neumühlen-Dietrichsdorf. The undertaking was favored by the fact that the ships were still on the ways when the decision was reached to re-build them into sea-lighters and that hauling-out or redocking was not necessary. Whereas the hull work of the torpedo boats was practically complete, hardly any machinery had been installed.

Since the pointed bow of the torpedo-craft appeared ill-adapted to a freight ship, its length was reduced by about 33 ft. and an existing bulkhead was retained as a collision bulkhead. For the purpose of marine classification a reduction in length was also desirable from the point of view of increasing strength-ratings. The stern of the ship remained unaltered, but the twin-screw shaft-extensions were removed, a matter to which a commission of the Entente attached great importance. In order to accommodate a single screw, a portion of the cast-steel stern-post was cut-out and a section containing a propeller-boss was fitted.

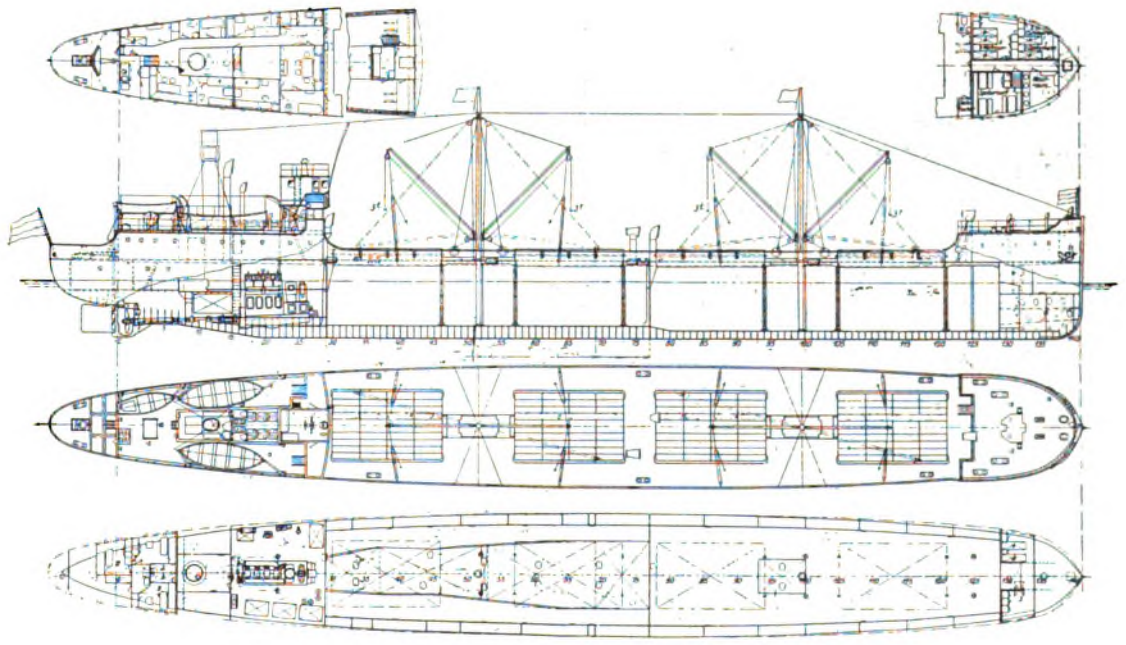
The re-built hulls have the following dimensions:

Length B.P.	235 ft.
Length O.A.	251 ft.
Breadth, M.D.	30 ft.
Depth M.D.	17 ft., 8 in.
Draught	12 ft., 10 in.
Displacement	1,674 long tons
Carrying-Capacity	1,181 long tons
Cubic Carrying-Capacity	56,900 cu. ft.
Gross Registry (Approx.)	950 tons

Weights are distributed as follows:

Hull of Torpedo-Boat	251 long tons
Removed Structures	74 long tons
Remaining Weight of Torpedo-Boat	177 long tons
Added Structures	98 long tons
Hull of Cargo-Ship	275 long tons
Fittings	79 long tons
Power-Plant	59 long tons
Fuel	47 long tons
Feed-Water	16 long tons
Drinking-Water	9 long tons
Total	485 long tons

Motive power for each of these ships is furnished by a single-acting direct-reversible four-cylinder Sulzer Diesel marine engine of 410 shaft H. P. built at the shops of Messrs. Sulzer Bros. Stock Company at Ludwigshafen. These are machines of a type of which 100 have been built in this size alone. They have all the characteristic features of the Sulzer two-cycle marine Diesel engine built at the Winterthur plant, such as port-scavenging, super-charging, simple reverse-gear, piston cooling, simple cylinder-head construction and many others. At a speed of 8 knots and with a fuel-consumption of 0.485 lb. per B.H.P. hour, it is possible for the ship to be under way for 22 days and to have a cruising radius of more than 4,200 sea-miles. The engine and propeller speed is 200 R.P.M.



Plan of one of two German destroyers converted to Diesel-engined freighters. A 410 b.h.p. Sulzer engine is installed in each boat

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Diesel-Electric Ship Propulsion

Questions Pertaining to Installation and Operation

By W. E. MARTIN
Marine Department, Westinghouse Electric & Mfg. Company

OF the various systems for propulsion of vessels in vogue at the present time, the Diesel-electric type of drive is the latest to arouse the interest of naval-architects, marine-engineers and ship-builders. As is always the case with a new scheme it is necessary to overcome amount of scepticism and ordinary Yankee "show me," before it will take its proper place as a means of propulsion.

In entering the marine field, the Diesel-electric adherents find already established, reciprocating steam-engines, geared-turbines, turbine-electric drive and Diesel-engine drive, all of which have certain merits for particular applications, but the Diesel-electric system has certain inherent advantages which should in general make it very desirable from several standpoints.

Some of the foremost people in shipping circles today are products of the school of "hard knocks," having spent years at sea with the old reciprocating-engine which accounts in part for the tendency on the part of marine-engineers towards conservatism and hesitancy to try out new methods of drive. When turbines for ship drive were introduced, they hesitated but finally saw the light and as newer and better machinery is brought out, they will again be convinced. It is the policy of the Westinghouse Company to recommend Diesel-electric drive only when it is better suited than some other form of drive. In this way the full merits of the system will not be placed at a disadvantage by a mis-application.

In this type of propulsion Diesel-engines are used as the prime movers furnishing power to the ship's propeller through generators, direct-connected to engines, which in turn supply power to the driving motor. The Diesel-engine driven generator-sets can be arranged in convenient sizes to give the total power required, these small comparatively high-speed sets weighing much less than would single low-speed engines connected directly to the propeller. Direct current is advocated rather than alternating current on account of simplicity of operation. Using direct-current generators makes it possible to run the engines at constant speed, and connecting the generators in series eliminates the necessity of close governing which would be necessary with machines in parallel.

If alternating current were used, it would probably be necesary to vary the speed of the engines in order to vary the propeller speed while with the direct-current series operation the speed of propelling-motor is varied by simply regulating the excitation of the generators. Motor speed variation may be obtained from zero to the maximum in either direction by means of a reversing rheostat, which will control the excitation of the generators supplying power to the motor. The motor will be separately excited at a constant value, and consequently the speed will vary directly with the generator voltage which will be regulated by the reversing rheostat. This arrangement makes it possible to operate the ship at almost any speed desired, either ahead of astern. This scheme of operation permits reversing of motor without interrupting the main circuits since only a relatively small generator field current is handled in the control.

Electrical Equipment

The motors are slow-speed direct-current type. Two pedestal sleeve-type bearings are furnished arranged for bolting directly to the ship structure and the shaft is furnished with forged flange for coupling to the propeller-shaft. The motor frame is split horizontally, the top half being readily removable for inspection and repairs. Feet are cast on the lower half of the frame, for bolting to the ship's structure. Motors are supplied usually of open self-ventilated type, but where space is limited it is possible to reduce the diameter and use forced ventilation, in which case a separate ventilating set is usually mounted directly above the motor. It is further possible to reduce the motor diameter by going to the double armature type similar to motors installed on submarines.

The generators are similar to the motor in construction, except that one pedestal bearing is supplied. A flanged shaft is provided for coupling to the engine-shaft. The exciters are small D. C. generators and can be supplied either for direct-connection to the main generator, arranged for chain-drive from the generator shaft, or for separate drive as an independent unit. The arrangement for excitation can be made as is best adapted to the particular installation. A complete spare exciter unit is recommended.

The switching equipment consists of a black marine switchboard for generator and motor, on which is mounted necessary switches, meters, and circuit-breakers including a panel of meters switches, and rheostats for control of the exciters. A reversing rheostat is mounted behind the switchboard and operated through rods and bevel gears, from levers on a pedestal which is mounted in front of the switchboard.

Where pilot house control is furnished, a polished brass operating pedestal is located in the pilot house, the reversing rheostat being mounted beneath the pilot house deck directly below. In front of the pedestal is a meter panel enclosed in a watertight metal cabinet with plate glass front, on which is mounted a voltmeter and speed indicator for the propelling motor.

The complete equipment has been especially designed for marine service. The apparatus is rugged; windings insulated and impregnated against moisture; bearings built to prevent oil leakage, and non-corrodible material used where necessary.

Advantages

Among the principal advantages of Diesel-electric drive can be enumerated:

1. **Flexibility and Reliability.**—With this system, the power plant can be divided into any convenient number of units depending upon the total power required and the available space for location. This allows of laying-out the ship most conveniently for handling the particular cargo to be carried. Further, and of great importance in case it is necessary, one or more generating units can be cut out, allowing the ship to proceed at a slight reduction in speed. This prevents complete shutdown in case of accident as it is hardly conceivable, that with three or four generating sets, all would be out of commission at the same time. By throwing the double-throw switch for any single generator the remaining machines will supply current at reduced voltage to the main motor. The voltage delivered being three-fourths of the total available it might be assumed that the motor would operate at three-fourth's speed, but by adjustment of the motor field through a small rheostat it is possible to increase the speed to a point absorbing the full power of the three remaining generator units giving the ship about ninety per cent of its full rated-speed. Taking the extreme case, that all generating units being down, which is of course improbable, it would still be possible to obtain steerage-way by supplying power from the small auxiliary set.

2. **Operation of Engines in One Direction.**—With Diesel-electric drive, it is only necessary to turn the engines in one direction, thus overcoming the necessity of a mechanical reversing devices as with Diesel engines direct-connected to the propeller.

3. **Simplicity of Operation.**—The form of control used with this type of drive is extremely simple and very effective. By voltage control through the generator fields, only comparatively small currents are handled (about one-half of one per cent of the main current) involving the use of no large cables, except for the motor leads. The motor can be started easily and quickly in either direction.

4. **Cost To Operate.**—This type of drive is very economical, using approximately one half the fuel required for propulsion by means of geared-turbines or turbine-electric equipment, either of the latter using less fuel than the reciprocating steam engine. For cruising at lower speeds one or more engines can be shut down thus effecting further economy.

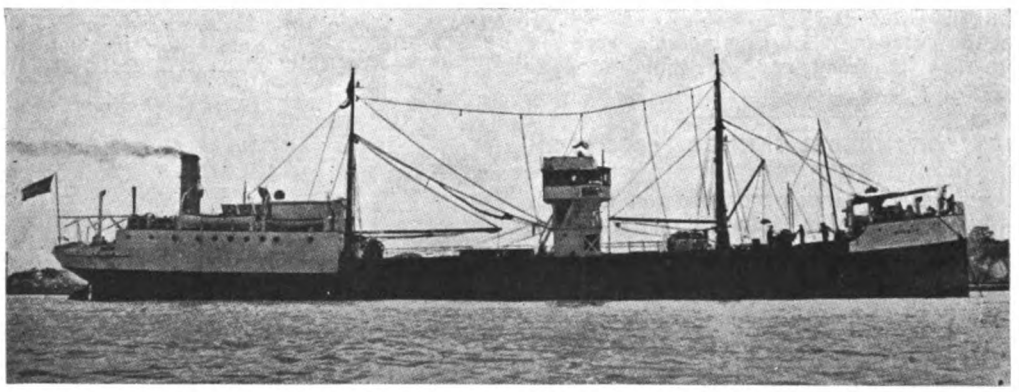
Possibilities Presented

Although the initial cost of an equipment of this kind compares favorably with other machinery it should be possible to further reduce same by quantity manufacture of both the engines and the generators.

By standardizing on a moderate size engine, it would be possible to use the same unit on almost any ship, one, two, three, four, or six units being installed according to the total power required. For example, take a cargo ship of 2,500 shaft H.P., which is about the power required for a large percentage of the ordinary tramp freighters of from 8,000 to 10,000 D.W. tons, and allowing for generator and motor efficiencies there would be required a total in engines of 3,000 B.H.P. This would require the use of four 750 H.P. engines, and if a fleet of four ships were involved it would allow the building of 16 similar engines. Smaller or larger vessels could use the same engines, in different quantities, making an ideal proposition from a manufacturing standpoint.

A particularly good application for Diesel-electric drive is found in the ordinary ferry-boat. With motor-drive the pilot can obtain almost instantaneous response, starting, changing speed, and stopping the motor at will. By connecting a motor directly so each screw of a double-ended ferry and placing the generating-units amidships, considerable space is saved since boilers and long propeller-shafting are no longer required. This allows additional carrying-capacity and subsequent saving in transportation costs. It is of interest to note that on the double-ended ferry boat, the apparent transmission loss of approximately fifteen per cent in the electrical equipment is fictitious and becomes an actual gain as compared with the ordinary method of driving both screws by one engine. This condition would apply where the after propeller is designed to deliver all the power required to propel the ship, the forward propeller being turned over at a speed just great enough to keep it from acting as a drag on the ship.

For yachts, Diesel-electric drive is also proving popular as evidenced by the fact that yacht owners and naval architects have indicated a strong interest, investigating in great detail the merits of the scheme. Two Diesel-electric propelled yachts with Westinghouse equipment have been built, one of which has an excellent record after a year's operation, the other to be put in service early this year.



"Drente," a 1,500 tons d.w.c. tanker built in 1908 as a lighter, but recently equipped with a pair of 320 b.h.p. Kromhout surface-ignition oil-engines, turning at 225 r.p.m. She is owned by the Nederlandsche Indische Tankstoomboot Co., and operated by the Anglo-Saxon Petroleum Co.

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Our Readers' Opinions

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)

WORLD'S HIGHEST SPEED DIESEL ENGINE.
To the Editor of "Motorship,"

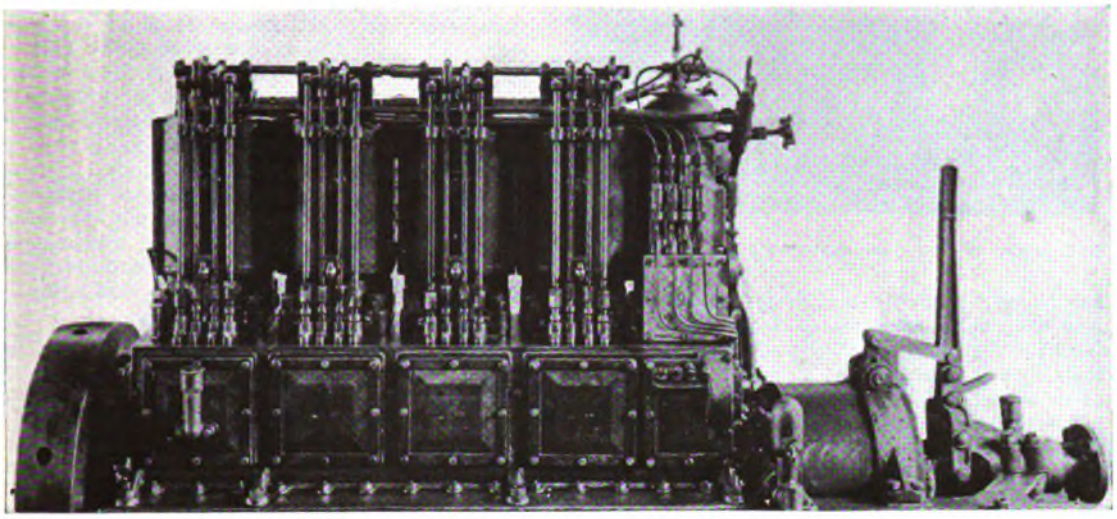
Enclosed is a photograph of my laboratory oil-engine, which is the smallest, highest and fastest running Diesel engine ever made in Japan, having four-cylinders 5⅝ in. bore by 9 in. piston stroke turning at 1,120 revs. per minute. It swings a 26 in. propeller. The injection of fuel is by the pneumatic system.

Yours very truly,

TANADA T.

560 Imahiraki, Nishinoda,
Kitaku, Osaka, Japan.

[So far as we have been able to trace, this Diesel-engine must hold a world's record for high speed of operation.—*Editor.*]



A Japanese marine Diesel engine that operates at 1,150 R.P.M. built by a reader of "Motorship"

CARGO SHIPS FOR REDERI STJARNAN
To the Editor of "Motorship,"

Under the heading **"Two Motorships for the Rederi Stjarnan,"** on page 205 of your May issue, it is stated that two motorships are being built for the account of the said owners and that Bergsund's surface-ignition oil-engines are being installed.

That, however, is not quite the fact, as of the two vessels dealt with in your article the first one is provided with a steam engine of Bergsund's construction. With regard to the other vessel the owners decided on a Polar Diesel engine of our make which develops normally 500 b.h.p. at 150 revs. per minute. Compared with the steamship a gain in space of about 500 cb. ft. is obtained by this, which is of the greatest importance, considering that the vessel is frequently to carry wood.

With reference to the motorship "Scania" on the same page of the same issue, she is propelled by one of our Polar Diesel engines of 500 b.h.p. and the speed of 10 knots referred to by you was obtained when the vessel was fully loaded.

Yours very truly,

AKTIEBOLAGET ATLAS DIESEL.

Stockholm, Sweden.

CONVERTING THE HOG ISLAND SHIPS.
To the Editor of "Motorship,"
Sir—

My attention has been called to a paragraph on page 292 of the April number of "Motorship" headed "Shipping Board to Convert Seventy Steamships to Diesel Power," in which you state that seventy of the A-type vessels built in Hog Island are to be converted to Diesel and Diesel-Electric propelling power as most of them are laid up because of shipping depression *and needful repairs.*

While we are replacing a number of defective gears and turbines of various types built during the war and which more than served their purpose at that time, the vessels in which such conversions are being made are not Hog Island A-type ships, and it is common knowledge to all Operators as well as to ourselves that these vessels have given a magnificent account of themselves, their upkeep and voyage repairs being practically nil and I think it is generally agreed everywhere that they compare in reliability and efficiency with vessels built anywhere.

These ships are fitted with double-reduction gears and General Electric turbines, have engine-room auxiliaries of simple and rugged type, and were all sent on their initial voyages with guarantee engineers and competent personnel. The records of the Hog Island A-type ships are open for inspection both at the Shipping Board and in the offices of any of the Operators who have handled them and will speak for themselves.

Very truly yours,

V. V. WOODWARD,

U. S. Shipping Board,
Div. of Construction & Repairs,
45 Broadway, New York City.

[The statements regarding the proposed conversion of 70 Hog Island ships, etc., were taken from a lengthy news article in the N. Y. "Tribune," which apparently emanated from the Shipping Board. We are glad to give publicity to your remarks and correct any erroneous impressions that may have arisen. Since publication of our April issue we have been advised by Admiral Benson that undoubtedly a number of the Board's vessels will soon be converted to Diesel and Diesel Electric drive.—*Editor.*]

DIESEL ENGINES OF BATTLE-MONITORS
To the Editor of "Motorship,"
Sir—

We have read in the March issue of your review "Motorship," the note relating the semi-submerged Diesel-driven Battle-Monitors, recently outlined by Ing. Nabor Soliani.

We have the honour to inform you that the internal-combustion oil-engines forming the propelling sets are four 6,000 b.h.p. "Ansaldo San Giorgio" type two-stroke engines; but, as the same are the first engines in the world designed and projected of so large power for such purpose, we regret not to be able to supply any further and more complete particulars on these engines, that we have studied for installing on board of naval war-craft.

Yours very truly,

THE DIRECTOR,
Ansaldo San Giorgio.

Via Cuneo, 20,
Torino, Italy.

PRODUCING AN AMERICAN ENGINE
To the Editor of "Motorship."
Sir:—

Now that the war is over, what is the answer to a question in the Nov., 1918, issue of your magazine; "What will the nation say if after the war it discovers itself saddled with hundreds of merchant-ships of an uneconomical type that cannot be operated against foreign motor-ships without imposing a heavy burden upon the people? American steam-ships cannot compete against the motor-ships of other countries." We only need to glance over shipping reports, newspapers or take a stroll down along the water front where there are many of the uneconomical steamers idle either for the want of cargos or companies who can operate them at a profit, to realize that this question is here to be answered.

It is a proven fact that steam-ships cannot compete with the motor-ships which our neighbors across the waters are building in large numbers. Are we still going to let them lay idle or convert them into "the best and most efficient type for the establishment and maintenance of service on steam-ship lines deemed desirable and necessary by the board, and such vessels shall be equipped with the most modern, the most efficient, and the most economical machinery and commercial appliances," which the Jones-Greene bill calls for?

Recently I have had the opportunity to witness the conversion of a turbine-driven tanker into a reciprocating steam-engine driven tanker and the complete removing of machinery in other ships in order that the hull might be remodeled. Is this practice still to continue or are the shipbuilders going to develop a Diesel-engine that they can stand back of which any farsighted ship-owner contemplating the remodeling of their ships would readily accept? But why should we expect the ship-owners to equip their ships with Diesel engines when many shipbuilders do not either build, handle or advocate these engines?

If there ever was an opportune time it seems that it is here for some of our well-equipped shipbuilders to enter this new field and reap some of the large profits that are sure to be derived therefrom.

Look at what has been done by the Bethlehem Steel and the Worthington Pump people. Many others are going to follow and it is the ones that get the early start that will establish themselves for some time to come.

With the idea of extreme simplicity in view and the designing of an engine that could be called an All-American engine, and one which carries some of the advantages claimed for both the two and four cycle types of engines, I have drawn some plans which are my ideas of how such an engine should be built.

Mr. Tornin has the right idea when he says: "Condemn the engine that has vital parts which can't be replaced without the help of the builders of the engine in any port of the world; condemn the engine that has parts which the average engineer will not understand by simply looking at them; condemn the engine which you cannot get at the most important parts without first clearing away a number of pipes and breaking a score of joints; condemn the engine which presents itself so nicely to the eye, but which is a perfect monster if you want to get at the crosshead-pins; condemn it, if you don't, it will condemn itself in a few years and you will be sorry you ever went in for Diesel engines. Which you should not be, as they have all the advantages claimed for them. You will not be sorry if you look before you leap!"

I believe that such an engine should be built without any great departure from the standard practice or design that has been so thoroughly tried out in Europe for several years. It seems that the four-cycle engine has advantage over the two-cycle where the large powers are not desired, and that the two-cycle has advantages over the four-cycle when its comes to economy of starting air and the flexibility of the engine.

My design is of the vertical single-acting, cross-head, direct-reversible type which operates on the four-stroke cycle when under power but which operates on the two-stroke cycle when maneuvering levers are in a start position at which the engine is operating on compressed air. Otherwise it is the same as a single-acting steam or air engine when starting.

The general design does not depart to any great extent from that of the old Burmeister & Wain or the Worthington engine. It is of the enclosed type with cast-iron columns in combination with steel rods or bolts, mounted on a heavy bed-plate which is in two sections. These cast-iron columns and steel bolts support a cylinder-base or entabulator and are so spaced that the after columns support the cross-head guide and the forward ones so that all moving parts are accessible when oil-guards are removed. This entabulator supports the cylinders which are cylindrical in form and arranged in sets of three that are controlled separately from each other.

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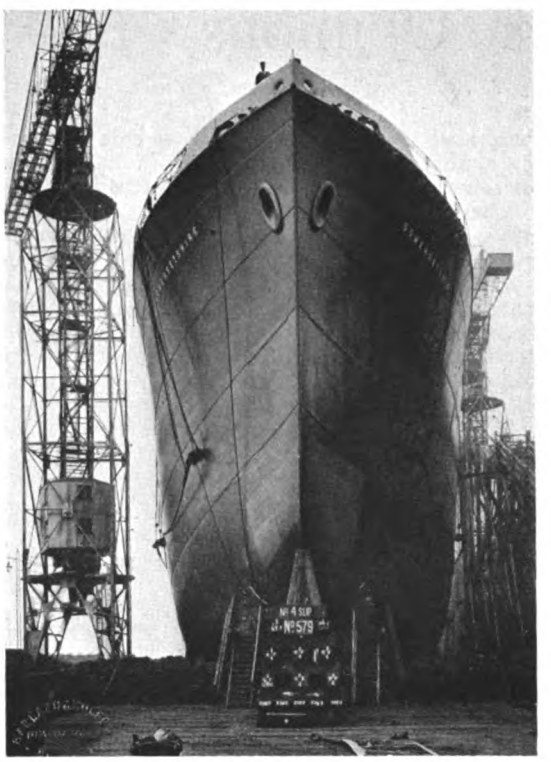
The control is by means of three levers which are mounted at the center of the length of the engine and operatable from the engine-room floor. There is one lever to control the speed of the engine and one to control each helf of the cylinders. The first movement from a central or stop position of the levers which control the maneuvering of the engine will admit starting air and a further movement will close starting air and admit fuel oil. For reversing these same levers are moved in the opposite direction from the central or stop position. All levers are so inter-locked as to make it impossible to operate other than in the proper sequence.

The construction of head and number of valves used does not vary any from that used by most any four-cycle engine. The only additional parts I have used to cause this engine to start on the two-stroke and afterwards shift to the four-stroke cycle when under power, is two cams and an additional cam-roller.

When the levers are in a start position and the engine is operating on compressed-air there is no compression to overcome, which enables the engine to get under motion at once with the consumption of a minimum amount of compressed-air. After the engine is under motion first one lever is thrown to the run position and the other following it up as soon as the first cylinder develops any power. If it is desired to use only one-half of the power cylinders one of the levers is left in a start position with the starting-air stop-valve left closed and the other is put in run position.

When the levers are so set but one-half of the engine is developing any power and the other half is simply revolving with the exhaust-valves opening every revolution. While one half is idle or powerless the other half is receiving a double amount of the fuel-oil to keep the engine going at the same speed, thus insuring regularity in the burning of the fuel and increasing the flexibility of the engine.

Simplicity in design and accessibility for overhauling are two points that should be borne strongly in mind all through the designing of any success motor for marine purposes. To those who have never made a trip to sea or had any experience with marine work such as repairing and installing of machinery it may be hard to impress upon them the importance of putting in a few hours thought in order that a piece of machinery may be made the simplest way possible. It is the man who has to worry his head day in an day out in order to keep one of those complicated engines going that can appreciate the value of an engine properly designed and manufactured.



Bow view of the new motorship "Somersetshire"

Every part is made as accessible as possible. In order that the piston and cylinders may be inspected it is only necessary to remove oil-guards and disconnect the top end of the connecting-rod in order to fetch the piston, piston rod, and cross-head out on the after side of the engine where they can be worked on with ease. It is not necessary to break any joints that are subject to high-pressures such as removing the piston head, etc., as is the customary way of doing. The oil-tight case for lubricating-oil is enclosed separately from the pistons so that it is impossible for carbons or water from piston cooling-pipes to get into lubricating-oil. As stated before columns are so spaced that all moving parts are clear when oil guards are removed and so that the forward one support the cross-head guides, and so that the main-bearings can be worked with to the best advantage.

Steel bolts and rods are so arranged that the cast-iron is not subject to any tension stresses at any part of the engine.

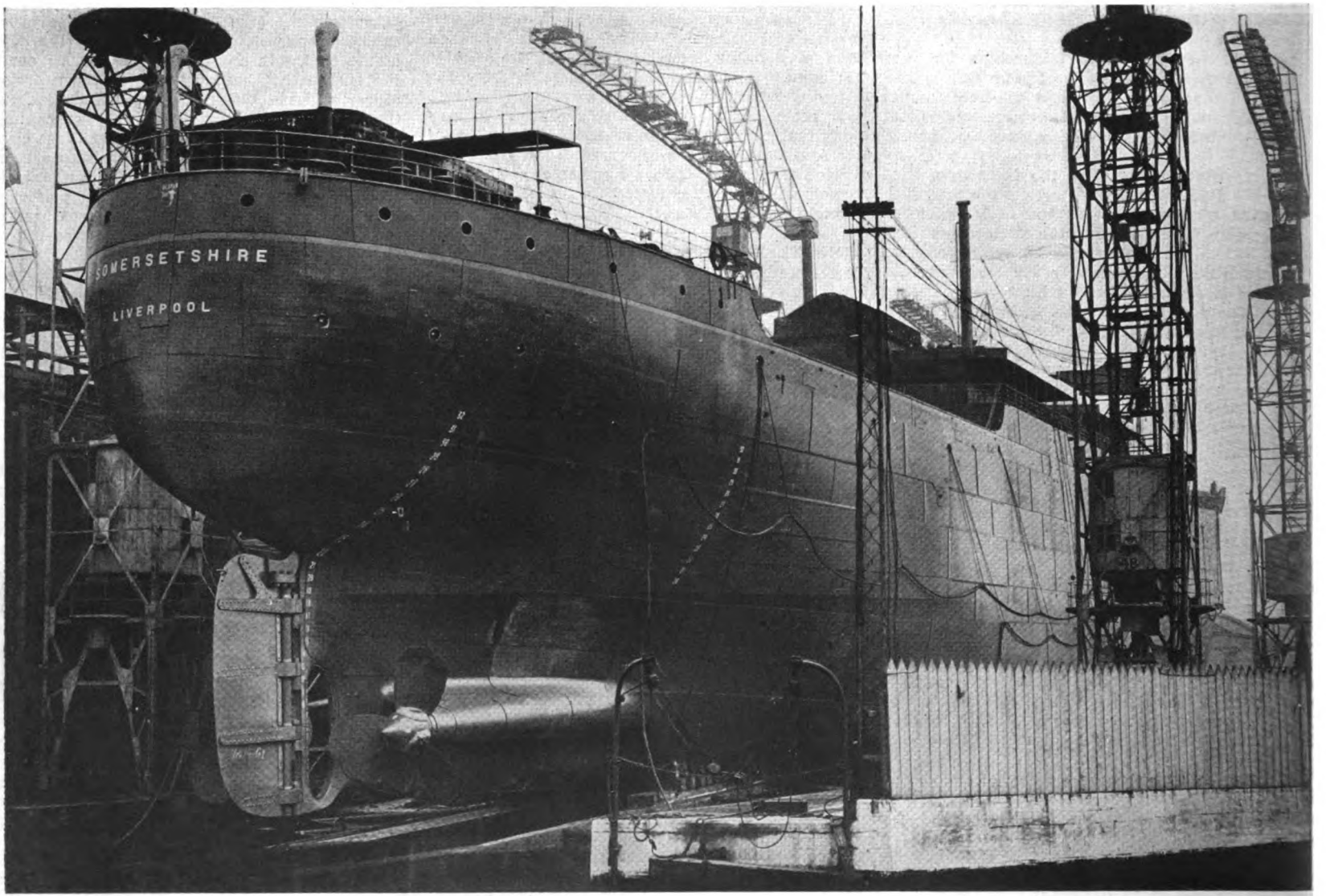
On the forward end of the engine is mounted the usual air-compressor for furnishing air to the fuel-valves and starting-air. It is of the three-stage type with the second stage being obtained by a differentiated piston. This is the usual way of providing a good distribution of loads. The first and third discharge on the up-stroke and the second on the down-stroke. The fuel-pumps are arranged in sets of three.

Finally, may I again ask. Is this practice of prodigality still to continue or is not there some way that the ships already built at a tremendous cost can be made to produce instead of having them blocking up the channels to navigation?

Yours very truly,

Oakland, Cal. ERNEST V. PARKER.

The Editor of "Motorship" is desirous of renting a motor cabin-cruiser or small motor-yacht of 30 to 45 ft. length for two weeks in July or August for cruising on Long Island Sound. Must have two cabins. Comfort greater consideration than speed. State terms, etc., and where boat can be inspected.



Bibby Line's second motorship, the "Somersetshire" just prior to her launching on Feb. 24th, at Harland & Wolff's Belfast yard. She is of 12,000 tons d.w.c. and is powered with twin 2,250 i.h.p. H. & W. Burmeister & Wain Diesel engines. A sister motorship, the "Dorsetshire" was fully described and illustrated on pages 889-890 of our issue of Oct., 1920, when her plans were also given

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